



Development Standards for Public Improvements and Construction Specifications

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**Development Standards for
Public Improvements and
Construction Specifications**

Amendment



**CITY of
DURANGO**

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November 30, 2001

To Whom It May Concern:

This book includes changes to the City of Durango Code of Ordinances regarding street layout and design.

The following Amendment is applicable to Section 1 – Development and Construction Standards.

If you have any questions, please contact the Public Works Department at 385-2860.

Yours truly,



Otha J. Rogers, P.E., Director
Public Works Department

Sec. 14-181. Street layouts and designations.

Arrangement of streets and selection of typical road sections shall conform as nearly as possible to and be compatible with the objectives established by the City Master Plan. In all cases, provisions shall be made for the extension of arterials and collectors, as designated on the master plan.

In neighborhoods designed for residential development, streets, except for cul-de-sacs, shall be configured to encourage low vehicle speeds. Streets designed for residential development shall have no reach of street longer than 800 feet without at least one of the following features: traffic turnaround, offset intersection, cul-de-sac, center landscaped median, curve of at least 90 degrees with a radius of no more than 200 feet, or drainage structures which require reduced speed.

Section 2. That Section 14-186 of the Code of Ordinances of the City of Durango should be and the same is hereby amended, in its entirety, as follows:

Sec. 14-186. Bicycle Ways.

Bicycle ways shall be provided on arterial and collector rights-of-way as shown on drawings numbered R-1B on file in the City Clerk's office. Bike lanes for new roadways shall be at least five (5) feet wide, as measured from the flowline of the gutter. Off-street bicycle ways may be required through subdivisions if they are part of an area bicycle system. Where off-street paved bikeways are provided, they shall have a minimum paved surface of ten (10) feet in width and a minimum right-of-way of twelve (12) feet in width.

Section 3. That Section 14-191(e) of the Code of Ordinances of the City of Durango should be and the same is hereby amended, in its entirety, as follows:

Sec. 14-191. Intersections.

(e) Curb corner radii at intersections shall be between ten (10) and twenty (20) feet, except that corner radii in commercial and industrial areas may be thirty (30) feet.

Section 4. That Section 14-193 of the Code of Ordinances of the City of Durango should be and the same is hereby amended, in its entirety, as follows:

Sec. 14-193. Driveways and curb cuts.

A maximum of one curb cut per dwelling unit is allowed in any residentially zoned area. Each residential curb cut shall be no more than twenty-four (24) feet wide and each commercial curb cut no more than thirty-five (35) feet wide, as shown in standard drawing No. R-4 on file in the City Clerk's office. Curb cuts larger than thirty-five (35) feet in width may be made in industrial zones where no sidewalks are proposed. Curb cuts shall be no closer than forty (40) feet from the intersection of any road as measured from the curblines extended. Curb cuts shall be no closer than twenty (20) feet apart as measured at the right-of-way line. Curb cuts shall be no closer than ten (10) feet from the property line as measured at the curblines from the property line extended.

Residential properties fronting collector or arterial roads shall not be allowed curb cuts which require backing into the public right-of-way. Where residential properties front both arterial or collector and local streets, access shall be allowed only from the local street.

In commercial areas, parking shall be accommodated so that no backing into the public right-of-way will be allowed except that backing into the public right-of-way of an alley is allowed.

Section 5. That Section 14-195 of the Code of Ordinances of the City of Durango should be and the same is hereby amended, in its entirety, as follows:

Sec. 14-195. Cul-de-sac and dead-end streets.

(a) Dead end streets are not allowed unless provisions are made for turning of emergency vehicles. The minimum pavement diameter for turning shall be seventy (70) feet. Configurations other than circular drives shall be allowed where maneuvering room comparable to a seventy (70) foot ~~radius~~ **DIAMETER** is provided.

(b) Dead-end streets proposed to be extended to connect with future development shall be provided with a temporary turnaround which will consist of a seventy (70) foot diameter graveled surface meeting base requirements of the paved section of the street.

(c) Maximum length of cul-de-sac shall be five hundred (500) feet. Maximum lengths of one thousand (1,000) feet are permitted when serving fewer than twenty (20) dwelling units.

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shall be readvertised, and at the time to which such sale was postponed shall again be offered for sale and sold to the highest bidder. Upon the sale of any property and the payment therefor a deed shall be executed to the purchaser in the same manner as provided for the execution of deeds in section 14-139.

(Code 1962, § 9-10-55)

Sec. 14-141. Deposits in surplus and deficiency fund.

All money received by the finance director/treasurer on account of the payment of assessments or installments thereof, the assignment or redemption of delinquency certificates, or for rents, issues and profits, or from the sale of property, title to which is held by the city for the benefit of any local improvement district, less any expenses of securing possession of such property, or for the care and operation and sale of the same, shall be deposited to the credit of the interest and bond fund of the local improvement district, in the same proportion as the assessment or installments for which the property was taken. Any money left in a local improvement district bond fund or any money derived from the rental or sale of any real property acquired by the city through sale for delinquent assessments or installments shall, after all warrants, bonds and coupons of such district, have been paid in full, be credited to the special surplus and deficiency fund of the city.

(Code 1962, § 9-10-56)

Sec. 14-142. Sale must equal funds used.

The city may use any available funds for the satisfaction of any lien prior in right to any special assessment lien created by the city. In the resale of any property to which the city has so acquired title, the city shall use its best efforts to sell the property for an amount at least equal to the funds so used plus the amount necessary to satisfy the special assessment lien or liens created by the city, principal, interest, penalties and collection costs. The monies received from such a resale in payment for the property shall be used firstly to satisfy such special assessment lien or liens and thereafter to restore to the funds from which any such prior liens were satisfied the monies used therefor. In accordance with the provi-

sions of this division, the city is authorized to acquire and dispose of property on which there are delinquent taxes or special assessments, or both.

(Code 1962, § 9-10-57)

Sec. 14-143. Restrictions when court proceedings pending.

No certificate of delinquency as provided for in this division shall be assigned or any property to which the city has taken a deed sold, on account of any assessment or installment thereof, during the pendency of any proceedings in court affecting the validity of such assessment.

(Code 1962, § 9-10-58)

Secs. 14-144—14-159. Reserved.

ARTICLE III. DEVELOPMENT AND CONSTRUCTION STANDARDS

DIVISION 1. GENERALLY

Sec. 14-160. Enforcement.

The provisions of this article shall be enforced and administered by the public works department of the city under the direction and supervision of the director of public works/city engineer.

(Code 1962, § 12-1-1)

Cross reference—Utilities, Ch. 25.

Sec. 14-161. Adoption of standard specifications for construction and specification drawings.

All construction of public improvements within the city shall be completed in accordance with the Standard Specifications for Construction of Waterlines, Sanitary Sewers and Storm Drainage Facilities (May, 1984); Standard Specifications for Construction of Streets and Roads (May, 1984); or Standard Specifications for Construction of Concrete Curb, Gutter and Sidewalk Construction (May, 1984), including compliance with the Specification Drawings which are an appendix thereto (hereinafter collectively referred to as "Standard Specifications for Construction"). The Standard Specifications for Construction shall be subject to

modification, from time to time, upon recommendation of the city engineer and the adoption of a resolution by the city council implementing and adopting such changes and modifications as may be recommended by the city engineer. A full and complete set of Standard Specifications for Construction shall be available for sale to the public at all times at the offices of the department of public works of the city. The cost to the public of acquiring a copy of the Standard Specifications for Construction shall not exceed the actual cost of reproduction of such material. Changes or modifications to Standard Specifications for Construction adopted pursuant to resolution of the city council shall be incorporated within the Standard Specifications for Construction as soon as reasonably practical after their approval and adoption. (Code 1962, § 12-3-1)

Secs. 14-162–14-177. Reserved.

DIVISION 2. DEVELOPMENT STANDARDS FOR PUBLIC IMPROVEMENTS

Sec. 14-178. Applicability.

(a) Where any provisions of this division impose more stringent requirements, regulations, restrictions or limitations than the minimums imposed or required by any other provisions of this Code or the statutes of the state, then the provisions of this division shall govern.

(b) No public improvements shall be installed nor shall any platted or dedicated street be used or improved except in compliance with this division. Whenever in this division, an action of the city council or an action of the planning commission requires the subdivider or developer to install water or sanitary sewer mains in the subdivision or development with an increase in size designed and intended to serve land other than that located within the subdivision or development, an agreement with the subdivider or developer to reimburse him for the cost of the increased size of the water or sanitary sewer mains may be entered into by subdivider or developer and the city council.

(c) All construction and installation of public improvements shall require compliance with ap-

plicable regulations pertaining to landscaping pursuant to section 26-16 et seq. (Code 1962, § 12-2-1)

Sec. 14-179. Definitions.

All words used in this division, except where specifically defined in this section, shall carry their customary meanings when not inconsistent with the context. The following words shall have the definitions ascribed to them in this section whenever they shall appear in this division:

Backfill means material placed in an excavated space to fill such space.

Base course means the upper course of the granular base of the pavement or the lower course of an asphalt concrete pavement structure.

Culvert means any structure not classified as a bridge, which provides an opening under or adjacent to the roadway.

Pavement means any surfacing of streets, alleys, sidewalks, courts, driveways or similar areas, consisting of mineral aggregate bound into a rigid or semi-rigid mass by a suitable binder such as, but not limited to, portland cement or asphalt cement.

Pavement structure means the combination of subbase, base course, and surface course placed on a subgrade to support the traffic load and distribute it to the road bed.

Private street means any vehicular access serving residential properties whose average daily traffic volume exceeds sixty (60) trips a day.

Public improvements means public facilities and shall refer to the construction or installation of streets, including curb and gutter, sidewalks, development or extension of the city water system, city sanitary sewer system, city storm sewer system, and landscaping.

Right-of-way means land, property or interest therein, usually in a strip, acquired for or devoted to a street, highway or other public improvement.

Road means an open way for purposes of vehicular and pedestrian travel.

Roadway means the improved portion of the right-of-way intended primarily for vehicular traffic.

Sewers means conduits and related appurtenances employed to collect and carry off water and waste matter to a suitable point of final discharge.

Shoulder means that portion of the roadway contiguous with the traveled way for accommodation of stopped vehicles, for emergency use, and for lateral support of base and surface courses.

Sidewalk means that portion of the street primarily constructed for the use of pedestrians.

Storm drain means any conduit and appurtenance intended for the reception and transfer of storm water.

Street the improved area of the right-of-way.

Structures means bridges, culverts, catch basins, drop inlets, retaining walls, cribbing, manholes, end walls, buildings, sewers, service pipes, under drains, foundation drains, fences, swimming pools and other features which may be encountered in the work and not otherwise classed in this division.

Subbase means the lower course of the base of a roadway, immediately above the subgrade.

Subgrade means the supporting structures on which the pavement and its special undercourses rest.

(Code 1962, § 12-2-2)

Cross reference—Definitions and rules of construction generally, § 1-2.

Sec. 14-180. Street and sidewalk standards generally.

The standards set forth in this division for right-of-way and road design are to be used in the design and construction of all new roads and as guides in the improvements of the existing street system. The objective in presenting street development standards is to establish factors which should be considered in the design process. The standards set forth in this division have been adopted by the city in the interest of safety, aesthetics and maintenance expense to the taxpayers of this community. All construction plans for roadways, sidewalks or bikeways shall be approved by the city engineer prior to beginning construction. (Code 1962, § 12-2-3(A))

Supp. No. 4

Sec. 14-181. Street layouts and designations.

~~Arrangement of streets and selection of typical road sections shall conform as nearly as possible to and be compatible with the objectives established by the city master plan. In all cases, provisions shall be made for the extension of arterials and collectors as designated on the master plan. (Code 1962, § 12-2-3(B))~~

Sec. 14-182. Access to buildings.

Access to buildings must be provided in accordance with the Uniform Fire Code, as published by the International Conference of Building Officials, chapter 10.107(a) and (c). Except for course and cul-de-sacs, streets will connect with streets already dedicated in adjoining or adjacent subdivisions, or provide for future connections to adjoining unsubdivided tracts, or should be a reasonable projection of streets in the nearest subdivided tracts. (Code 1962, § 12-2-3(C))

Sec. 14-183. Rights-of-way.

(a) Street rights-of-way must be sufficient to accommodate vehicular traffic, bicycles, pedestrians, all public utilities and on-street parking, special storm drainage facilities or other special treatments such as medians or traffic channelization.

(b) In accordance with the urban street standards see drawings numbered R-1A through R-1E on file in the city clerk's office for all public ways hereafter dedicated and accepted, the minimum right-of-way for streets, alleys, bikeways or pedestrian ways shall not be less than the minimum dimensions for each classification as follows and shall be in accordance with the city master plan:

Type of street	Length (in feet)
Major arterial	80
Collector	70
Local	60
Court	60
Cul-de-sac	60 (radius)
Alley	20

(c) Greater widths may be required by the city engineer when the need for such additional width

is supported by a traffic study. A drainage easement, in addition to the provided street right-of-way width, may be required where streets parallel streams or drainage area. The widths of such drainage easements shall be determined by the city engineer.
(Code 1962, § 12-2-3(D))

Sec. 14-184. Pavement widths.

Roadway pavement widths shall be in accordance with the urban street standards (see drawing Nos. R-1A through R-1E on file in the city clerk's office). Alleys shall have a minimum pavement width of twenty (20) feet.
(Code 1962, § 12-2-3(E))

Sec. 14-185. On-street parking.

On-street parking within the city rights-of-way shall be parallel only for all new development. Off-street parking for vehicles shall be provided as called for in section 27-453. Any proposed variations from the standard on-street parking provisions must be approved by the city engineer.
(Code 1962, § 12-2-3(F))

Sec. 14-186. Bicycle ways.

~~Bicycle ways shall be provided on arterial and collector rights-of-way as shown on drawings numbered R-1B through R-1D on file in the city clerk's office. Off-street bicycle ways may be required through subdivisions if they are part of an area bicycle system. Where off-street bikeways are provided, they shall have a minimum paved surface of eight (8) feet in width and a minimum dedicated right-of-way of ten (10) feet in width.
(Code 1962, § 12-2-3(G))~~

Sec. 14-187. Landscaping.

Landscaping must be planned to contribute to safety. Landscaping must not create visual obstructions to motorists or pedestrians particularly at intersections and access points. No tree shall be located within two (2) feet of any street curb. Low maintenance plantings are required. Planning of street landscaping shall give consideration to location of existing or proposed underground

utilities. For further landscaping requirements see section 26-16 et seq.
(Code 1962, § 12-2-3(H))

Sec. 14-188. Street lighting.

Street lighting and associated underground electrical supply circuits are required for all streets in or on the periphery of all new developments. Developers shall install a minimum of one (1) street light at every intersection. If a subdivision block length exceeds eight hundred (800) feet, one (1) street light shall also be installed at midblock.
(Code 1962, § 12-2-3(I))

Sec. 14-189. Horizontal alignment of arterial streets.

(a) Arterial streets shall be designed in accordance with AASHTO "A Policy on Arterial Highways in Urban Areas." Collector and local roadway curves should be designed with the following radius controls:

<i>Type of street</i>	<i>Radius control (feet)</i>
Collector	400 minimum
Local	200 minimum
Local	125 where superelevation is practical

(b) There shall be a tangent at least one hundred (100) feet long between reverse curves on all streets.
(Code 1962, § 12-2-3(J))

Sec. 14-190. Vertical road alignments.

(a) Vertical road alignments should relate to the natural topography insofar as is practical so as to minimize the need for cuts or fills while being consistent with safe geometric design.

(b) Arterial streets shall be designed in accordance with AASHTO "A Policy on Arterial Highways in Urban Areas."

(c) All changes in roadway grade of greater than five-tenths of one (1) percent for arterials and one (1) percent for local or collector streets shall be connected by parabolic curves of not less than one hundred (100) feet but of such length to provide for the following minimum stopping sight distances:

<i>Type of street</i>	<i>Stopping sight distance (in feet)</i>
Arterial and collector	275
Local	200

(d) Grades for collector or local streets in commercial or industrial areas shall not exceed six (6) percent. Grades for local residential streets should be as flat as is consistent with the surrounding terrain and shall be less than ten (10) percent. Continuous change of grade so as to give a roller-coaster effect shall not be permitted.

(e) In order to provide for proper drainage, the minimum grade to be used for roadways with gutters shall be three-tenths of one (1) percent. Where grades of four (4) percent or steeper are necessary, an analysis of drainage inlet bypass and soil erosion in ditches or swales shall be performed and mitigation facilities provided as required.

(f) The gradient within one hundred (100) feet of any four-way street intersection shall not exceed five (5) percent. Every effort should be made to keep grades at street intersections as flat as possible and in all cases the required sight distances shall be provided. Three-way street intersections shall have similar requirements unless circumstances warrant different grades as determined by the city engineer.

(g) All pavements on local or collector streets shall have a normal crown with a typical cross-slope of three-hundredths foot per foot. Pavement cross-slope on local or collector streets at intersections or in special cases shall not exceed five-hundredths foot per foot.

(h) Maximum side slopes between the curb and any existing or proposed structure shall not exceed one to one (1:1) on cuts or two to one (2:1) on fill areas. Side slopes between curb and right-of-way lines shall not exceed the natural angle of repose as determined from analysis of soil conditions. (Code 1962, § 12-2-3(K))

Sec. 14-191. Intersections.

(a) Streets shall be laid out so as to intersect at right angles, except where topography or other sight conditions justify variations. In no case shall

the angle of intersections vary more than twenty (20) degrees from a right angle. No intersection of public or private streets shall be on a curve of centerline radius less than five hundred (500) feet. No curb cut will be allowed on a curve section of road whose inside curve radius is less than one hundred fifty (150) feet.

(b) Intersections shall be designed with adequate corner sight distance. Corner sight distances is defined as measured from a point on the centerline of the right-hand travel lane of the minor road at least fifteen (15) feet from the edge of a major road pavement and measured from a height of eye of three and three-fourths (3¾) feet on the minor road to a height of object of four and one-half (4½) feet on the centerline of the travel lanes of a major road. The corner sight distance for local and collector streets shall be a minimum of two hundred (200) feet. On arterial streets, corner site distance shall be three hundred fifty (350) feet. In addition to the corner sight distance requirement, no fence, wall, entrance, hedge, shrub planting, tree or other sight obstruction greater than two and one-half (2½) feet above the pavement elevation shall be located within the triangular area formed by curblines and line connecting them at points thirty-five (35) feet from their point of intersection.

(c) Streets entering the opposite sides of a street shall either be directly across from each other or offset by at least one hundred twenty-five (125) feet from centerline to centerline.

(d) Streets shall not enter onto the same side of a street at intervals of less than three hundred (300) feet from centerline to centerline.

~~(e) Curb corner radii at all intersections shall be a minimum of twenty (20) feet.~~

(f) Street signs shall be provided by the developer at all intersections (see drawing number R-7 on file in the city clerk's office).

(g) Intersections which include collector or arterial streets shall be designed to allow for future traffic signalization. Geometry and all other details of these intersections shall be approved by the city engineer.

(Code 1962, § 12-2-3(L))

Sec. 14-192. Storm drainage system.

The road system in most cases will be a primary element of the storm drainage collection system of a developed area. Wherever possible, road layouts and grades should be designed to avoid excessive runoff concentration and to minimize the need for storm sewers. Curbed roadways provide drainage outfall for adjacent properties and site grading generally should provide for runoff from sites toward the roadway. If major drainways exist or are proposed through a development, the storm runoff should be routed to that drainway. All storm drainage system components shall be designed in accordance with the standards, policies and criteria of the city urban storm drainage master plan.

(Code 1962, § 12-2-3(M))

Sec. 14-193. Driveways and curb cuts.

A maximum of one (1) curb cut per dwelling unit is allowed in any R-1 or R-2 zoned area. Each residential curb cut shall be no more than twenty-four (24) feet wide and each commercial curb cut no more than thirty-five (35) feet wide, as shown in standard drawing no. R-4 on file in the city clerk's office. Curb cuts shall be no closer than forty (40) feet from the intersection of any road as measured from the curbline extended. Curb cuts shall be no closer than twenty (20) feet apart as measured between driveways at the right-of-way line. Driveway curb returns shall have a minimum radius of five (5) feet and maximum radius of ten (10) feet.

(Code 1962, § 12-2-3(N))

Sec. 14-194. Sidewalks, curbs and gutters, cross pans.

(a) Sidewalks and curbs and gutters shall be constructed as shown on standard drawing no. R-3 on file in the city clerk's office. Handicap ramps shall be installed at all intersections. Difference in top of curb elevations across any roadway shall not exceed three-tenths feet except where required for superelevation of the roadway and at intersections.

(b) Roads shall be designed so that drainage is carried in concrete gutters. Road cross sections shall be so designed as to prevent sheet flow across

roadways except where concrete cross pans are provided. Cross pans shall be constructed in accordance with standard drawing no. R-4 on file in the city clerk's office. Where storm drains are provided, no cross pans will be allowed. Cross pans are not allowed across collectors or arterials.

(c) Sidewalks will not be required on a side of a roadway which is not developable unless it is required to connect developed areas on the same side of the roadway.

(Code 1962, § 12-2-3(O))

Sec. 14-195. Cul-de-sac and dead-end streets.

(a) Dead-end streets are not allowed unless provisions are made for turning of emergency vehicles. The minimum pavements diameter for turning shall be eighty (80) feet.

(b) Dead-end streets proposed to be extended to connect with future development shall be provided with a temporary turnaround which will consist of a one hundred (100) foot diameter gravelled surface meeting base requirements of the paved section of a street.

(c) Maximum length of cul-de-sac shall be five hundred (500) feet where the cul-de-sac serves twenty (20) or more units. Maximum lengths of one thousand (1,000) feet are permitted when serving fewer than twenty (20) units in residential areas.

(Code 1962, § 12-2-3(P))

Sec. 14-196. Pavement thickness.

(a) Unless substantiated by detailed structural design using the state, department of highways' roadway design manual or other acceptable design method, the following minimum compacted thickness of asphalt and aggregate base will be used:

Type of street	Asphaltic concrete (inches)	Aggregate base class 6 (inches)	Aggregate subbase class 2 (inches)
Culs-de-sac and alleys	2	2	6
Local (residential traffic only)	2	4	6

Type of street	Asphaltic concrete (inches)	Aggregate base class 6 (inches)	Aggregate subbase class 2 (inches)
Local (commercial and residential traffic)	3	4	6
Collector	4	8	—
Minor arterial	(structural design required)		
Major arterial	(structural design required)		

(b) On roadway projects exceeding four hundred (400) lineal feet of pavement of public road, a pavement design based on soils analysis will be required.
(Code 1962, § 12-2-3(Q))

Sec. 14-197. Water system standards generally.

All water distribution facilities installed within public rights-of-way or easements shall be constructed in accordance with the standard drawings and constructed in accordance with the standard drawings and construction specifications of the city. In addition, all minimum standards of the state department of health shall be followed in the planning and construction of the water pumping, distribution and transmission facilities. All water system construction plans shall be approved by the city engineer prior to beginning of any construction.
(Code 1962, § 12-2-4(A))

Sec. 14-198. Waterlines.

(a) Water main extensions and replacements shall be a minimum of eight (8) inches in diameter. Extensions to serve limited development may be served by a six-inch main where no potential exists for future development and where fire flow requirements can be met. Larger mains may be required in accordance with ISO firefighting requirements or the city master water plan. All mains shall be extended to the furthest property line of any lot or development where future development is at all possible. All waterlines shall be looped, if possible.

(b) Generally, waterlines will be located five (5) feet south of the north curbline of east-west

streets and five (5) feet west of the east curbline on north-south streets.

(c) Lines shall be installed with a minimum of four (4) feet of cover to the proposed or existing grade whichever may be less. The developer will be responsible to set grade stakes to ensure proper depth for all waterline installations.

(d) Waterlines shall be installed before paving or repaving of existing or proposed roads.
(Code 1962, § 12-2-4(B))

Sec. 14-199. Valves.

(a) Three (3) gate valves are required at each main line tee except fireline.

(b) Any extensions to the end of property which cannot be looped shall be terminated with a gate valve at least nine (9) feet in length of pipe and plug and thrust block.

(c) Air/vacuum release valves will be installed at all high points in transmission lines. Air release valves shall be installed in distribution system lines as required by the city engineer.

(d) Gate valves shall be located so that no more than about seven hundred (700) feet of main line would be out of service due to a break anywhere in the main line. Flush valves shall be installed at all natural drainage crossings in accordance with the standard drawing.

(e) All-weather vehicular access shall be provided to each valve location.
(Code 1962, § 12-2-4(C))

Sec. 14-200. Water pressure.

(a) Water shall be supplied to each building in any development at pressures not less than forty (40) psi during peak consumption hours with all water tanks operating one-half full. Any development unable to meet this requirement shall provide complete plans for a booster pump and tank system which shall be approved by the city engineer.

(b) Water shall be supplied in each development at pressures not exceeding one hundred ten (110) psi at any building under static conditions. Any

development unable to meet this requirement must supply individual pressure reducing valves in service lines to the buildings.

(c) In no case shall pressures in excess of one hundred eighty (180) psi be allowed in any main line under static conditions. A main line pressure reducing station shall be designed by the developer and approved by the city engineer for any development whose pressures would exceed the one hundred eighty (180) psi limit.

(Code 1962, § 12-2-4(D))

Sec. 14-201. Hydrants.

Hydrants shall be located in accordance with the Uniform Fire Code and shall be installed as shown in standard drawing no. W-1 on file in the city clerk's office. One (1) hydrant should be located at the intersection of all streets. All hydrant locations are subject to approval by the director of fire services. Hydrant tee, valves and waterline runs to the curblines shall be installed where potential development may occur along a street to be paved or repaved as a part of the development.

(Code 1962, § 12-2-4(E))

Sec. 14-202. Sewer line crossing.

(a) Should the condition exist where a sewer main must be constructed crossing above or below a water main, the minimum clear distance vertically shall be six (6) inches.

(b) When sewer mains cross above water mains or within a vertical clear distance of eighteen (18) inches below water mains, the crossing must be constructed so as to protect the water main. (see drawing no. W-5 on file in the city clerk's office.)

(c) Minimum water main protection under these conditions shall consist of the installation of an impervious and structural sewer (e.g. vitrified clay or PVC, with concrete encasement, cast iron or ductile iron pipe) for a distance of ten (10) feet each side of the water main. In all cases, suitable backfill or other structural protection shall be provided to preclude settling or failure of the upper pipe.

(d) In no case shall a water main be located closer than ten (10) feet horizontally from a main

sewer line unless the sewer line is of cast or ductile iron construction.

(Code 1962, § 12-2-4(F))

Sec. 14-203. Water service lines.

(a) All buried service lines shall be of type K copper. Service lines including curb stop and box shall be installed from the main to the property line for each existing or proposed lot which is along a roadway to be paved as part of the improvement project. (see drawing no. W-7 on file in the city clerk's office.) Service line locations must be noted on construction plans and as-built drawings.

(b) Separate service lines shall be supplied to each separately owned parcel of land. Townhomes and single-family dwellings shall have separate service lines to each dwelling unit. Condominiums and apartments may be served by a common line to each building. Where two (2) or more commercial buildings lie on a single parcel, each shall have a separate service line.

(Code 1962, § 12-2-4(G))

Sec. 14-204. Water service taps; fee.

(a) Tap fees and plant investment fees must be paid prior to any connection being made. The city water department will make service taps into all existing waterlines. The service line taps in all new main lines shall be made prior to pressurizing the water main.

(b) Main line connections must be approved and inspected by the city water superintendent.

(Code 1962, § 12-2-4(H))

Sec. 14-205. Sanitary sewer system standards generally.

All sewer collection and pumping facilities installed within public rights-of-way or easements shall be constructed in accordance with standard drawings and construction specifications of the city. In addition, all minimum standards of the state department of health shall be followed in planning and construction of wastewater pumping and collection facilities. All sanitary sewer plans shall be approved by the city engineer prior to beginning construction.

(Code 1962, § 12-2-5(A))

Sec. 14-206. Slope of sewer lines.

(a) Minimum slopes of sewer lines shall be as follows:

Type	Slope (percent)
4-inch service	1.0
6-inch service	1.0
8-inch main	0.5
10-inch main	0.4
12-inch main	0.3

(b) Larger mains shall be designed to transport average sewer flows at minimum mean velocities of two (2) feet per second under flowing full conditions.

(c) Maximum design velocity for sewers flowing full shall not exceed ten (10) feet per second. Slopes between manholes must be constant. (Code 1962, § 12-2-5(B))

Sec. 14-207. Minimum pipe size.

Minimum pipe size for mains shall be eight (8) inches. Pipe shall be installed in accordance with line sizes recommended in the sanitary sewer master plan. Where line sizes are not recommended in the master plan the city engineer will determine the appropriate line sizes. (Code 1962, § 12-2-5(C))

Sec. 14-208. Location of sewer lines.

(a) Sewer lines shall be located generally on the centerline of streets but in no case shall main line sewer be located closer than ten (10) feet horizontally from the water main unless the sewer line is encased or of cast or ductile iron pipe. (see drawing no. W-5 on file at the city clerk's office). Depth of sewer shall be at least three (3) feet from top of pipe to proposed or existing grade, whichever is lower.

(b) Deeper installation may be required by the city engineer to serve future growth. Structural design must be demonstrated for line to be laid deeper than ten (10) feet.

(c) Lines laid between manholes must be straight. No curved sewers will be allowed.

(d) Sewer lines shall be extended to the farthest boundary of subdivisions or property being served where future development is possible. Sewer lines shall be installed before paving or repaving of existing or proposed roads. (Code 1962, § 12-2-5(D))

Sec. 14-209. Manholes.

(a) Manholes shall be placed:

- (1) At all changes in alignment;
- (2) At all changes in grade;
- (3) At intersections of two (2) or more main lines;
- (4) At intervals no greater than four hundred (400) feet along a main; and
- (5) At the end of all mains (cleanouts on mains are not acceptable).

(b) Drop manholes shall be designed whenever elevation differences between any two (2) inverts is twenty-four (24) inches or greater. (see drawing no. S-4, sheet 3 on file in the city clerk's office.)

(c) All manholes shall be accessible by gravelled access. (Code 1962, § 12-2-5(E))

Sec. 14-210. Service lines.

Service lines shall not enter at manholes. Service lines to eight (8) or more units in an apartment or condominium building shall be six (6) inches. Separate service lines must serve each building on a parcel of land. Each parcel of land must have its own service lines. Service lines shall be extended to each lot or proposed lot line along any road which is to be paved or surfaced before paving occurs. Townhouses shall be served with individual four-inch service lines, one (1) to each unit. (Code 1962, § 12-2-5(F))

Sec. 14-211. Force mains.

Minimum size of force mains shall be four (4) inches. Pipe shall be sized such that maximum velocity does not exceed six (6) feet per second.

Force mains should be installed at a positive grade to a manhole where a gravity sewer line begins. Where positive grades cannot be maintained, air and vacuum release valves must be installed at all relative high points in the line. Minimum depth for force mains shall be four (4) feet.
(Code 1962, § 12-2-5(G))

Sec. 14-212. Lift stations.

(a) Lift stations are discouraged. When necessary, they shall be designed to serve an entire subbasin. All lift stations will be of the wet well/dry well design. (see drawing no. S-3 on file in the city clerk's office.) All designs are subject to approval of the city engineer, and in addition to meeting state health department criteria, shall include:

- (1) Auxiliary alarm systems, with provisions for connection to the city's central alarm center by hardline telephone line;
- (2) Auxiliary power supply (see state health department requirements);
- (3) Control panel which provides for:
 - a. Automatic alternator for lead-lag operation;
 - b. Automatic reset;
 - c. Hour meter for each pump motor;
 - d. Low voltage protection relays;
 - e. Running overload and high level lights;
 - f. HOA switch for each pump;
- (4) Basket strainers that are easily accessible;
- (5) Mercury bulb float switches;
- (6) Auxiliary heaters and insulation in the dry well;
- (7) Separate check and gate valves for each pump;
- (8) Dry well sump pump or drain outlet;
- (9) Epoxy paint coatings inside and outside for all metal surfaces.

(b) Wet and dry well lids should be twelve (12) inches above finished grade. Designs should state the consequence of power failure on the lift station and population served by the lift station.
(Code 1962, § 12-2-5(H))

Sec. 14-213. Storm sewer system standards generally.

(a) All storm sewer collection facilities within public rights-of-way or easements shall be constructed in accordance with standard drawings and construction specifications of the city. In general, storm sewers or surface drainage channels and culverts shall be installed when the carrying capacity of the street is exceeded based on the following chart:

ALLOWABLE USES OF STREETS FOR DRAINAGE

<i>Street Classification</i>	<i>Minor storm runoff (10-year)</i>	<i>Major storm runoff (100-year)</i>
	<i>Maximum roadway encroachment</i>	<i>(Allowable depth and inundation)</i>
Local	No curb overtopping; where no curbing exists, encroachment shall not be over property lines. Flow may spread to crown of street.	Inundation: Residential dwellings, public, commercial and industrial buildings shall not be inundated at ground line, unless buildings are flood-proofed. Depth of water over gutter flowline shall not exceed twelve (12) inches.
Collector	No curb overtopping (same as above). Flow spread must leave at least one (1) ten-foot lane free of water.	(Same as above)
Arterial	No curb overtopping (same as above). Flow spread must leave at least one (1) ten-foot lane free of water in each direction.	Inundation: (same as above). Depth of water at street crown shall not exceed six (6) inches, to allow operation of emergency vehicles. Depth of water flow line shall not exceed eighteen (18) inches.

(b) All storm sewer plans shall be approved by the city engineer prior to construction.
(Code 1962, § 12-2-6(A))

Sec. 14-214. Storm sewer pipe size.

(a) The minimum pipe size for storm sewers or culverts shall be twelve (12) inches nominal diameter. Sizes required shall be as shown in the

urban storm drainage master plan. Where not covered in the master plan, storm drains shall be sized to transport the flow of a ten-year flood from the fully developed subbasin in which the development lies to a natural drainage course or other point acceptable to the city engineer. Design parameters given in the master plan shall be used in the calculation of the ten-year flood from subbasins of less than two hundred (200) acres.

(b) For project sites of two hundred (200) acres or more, a method similar or equivalent to that identified in the Soil Conservation Service Procedures for Determining Peak Flows in Colorado Technical Release No. 55 shall be used.

(c) Minimum depth of storm sewers from the top of pipe to finished grade shall be two and one-half (2½) feet.

(Code 1962, § 12-2-6(B))

Sec. 14-215. Storm sewer slopes.

The minimum slope for storm sewers shall be such as to maintain a flowing full velocity of two and one-half (2½) feet per second. Energy dissipaters must be installed in storm sewers where maximum velocity in the storm sewer would exceed ten (10) feet per second.

(Code 1962, § 12-2-6(C))

Sec. 14-216. Storm sewer inlets.

Inlets must be constructed in accordance with standard drawings at all locations necessary to prevent the sheet flow across paved road or private property of a two-year flood. (see drawings numbered SS-2 through SS-4 on file in the city clerk's office.) Double inlets are required on all streets where gutter slopes exceed five (5) percent and as required by good design practice.

(Code 1962, § 12-2-6(D))

Sec. 14-217. Storm sewer outlets.

Outlets to Junction Creek and the Animas River shall be located above the ten-year flood level and shall be protected with a concrete headwall.

(Code 1962, § 12-2-6(E))

Sec. 14-218. Storm sewer manholes.

Manholes for storm sewers are required at:

- (1) Change in grade;
- (2) Change in alignment;
- (3) Intersection of two (2) or more storm sewers; and
- (4) Intervals no greater than four hundred (400) feet for twenty-four (24) inches and smaller, five hundred (500) feet for forty-eight (48) inches and smaller, six hundred (600) feet for all others.

(Code 1962, § 12-2-6(F))

Sec. 14-219. Culverts.

(a) Culverts, where required, shall have twelve (12) inches of cover under roads. Culverts shall begin and terminate with headwalls as shown in the standard drawing no. SS-7 on file in the city clerk's office.

(b) Culverts design shall be in accordance with the state department of highway's design manual. Capacity design calculations shall be submitted along with plans for circular and box culvert design.

(c) No inverted siphons shall be permitted.

(Code 1962, § 12-2-6(G))

Secs. 14-220—14-234. Reserved.

DIVISION 3. CONSTRUCTION STANDARDS FOR PUBLIC IMPROVEMENTS

Sec. 14-235. Approval, acceptance of plans.

Construction standards for streets and utilities as set forth in this division shall be followed in the design and construction of public facilities. Two (2) prints of construction plans must be submitted for approval. All plans must be approved by the city engineer in writing. Once approved, plans will not be amended without approval of the city engineer. An improvements agreement between the city and owner must be entered into prior to construction of any public facilities. Ac-

ceptance of each phase of construction of public improvements (water, storm sewer, sanitary sewer, roads, etc.) is contingent upon:

- (1) Submittal of approved as-built plans;
- (2) Submittal of test results required as part of the city specifications; and
- (3) A final inspection by the city engineer and the owners or their representatives. After final inspection, the city engineer shall inform the owner in writing of any deficiencies and whether or not a reinspection will be necessary. Reinspections by city personnel after the second inspection shall require an inspection fee to be paid by the owner pursuant to a schedule of fees adopted by resolution of the city council.

(Code 1962, § 12-1-2)

Sec. 14-236. Submission of construction plans—Roads.

(a) Road construction plans must be sufficiently complete to provide assurance of compliance with design standards. Plans must contain a statement that all facilities are to be installed in accordance with the latest revisions to the Standard Specifications for Construction of Streets and Roads. Additionally, the plans or accompanying report must provide the following:

- (1) Plan and profile of original grounds and design elevation of roadway centerline or each curbline;
- (2) Design calculations and structural sections for pavement design, or minimum required section per city specifications;
- (3) Approximate location of existing and proposed underground utilities and exact location by station of existing and proposed drainage structures and piping and profiles of any drainage piping under the proposed construction;
- (4) Soil test report;
- (5) Details of any road structures and street cross sections at fifty-foot intervals where side slopes exceed four to one (4:1) slope;

(6) Existing and proposed physical features within twenty (20) feet of the construction including geologically unstable areas, trees, cliffs, ponds, ditches and other topographic features;

(7) Right-of-way lines, easement lines, street names, one-hundred-year floodplain, benchmarks, origin of survey, basis of bearing, section, township, range and professional engineer's seal.

(b) Construction plans should be provided in the same general format as preliminary improvement plans are submitted per subdivision procedures.

(c) As-built plans shall include all information required in the construction plans and shall provide additional or revised information when changes in horizontal alignment exceed three (3) feet or vertical alignment exceeds twenty-five hundredths (0.25) feet. If the standards are compromised or if public facilities are installed outside of public rights-of-way or easements, as-built plans shall note the same. As-built plans shall be stamped by a professional engineer certifying that facilities were installed in substantial accordance with approved plans.

(Code 1962, § 12-1-3)

Sec. 14-237. Same—Waterlines.

(a) Waterline construction plans must be sufficiently complete to provide assurance of compliance with design standards. Construction plans must contain the statement that all facilities are to be installed in accordance with the Standard Specifications for Construction of Waterlines, Sanitary Sewers and Storm Drainage Facilities. Additionally, the plans or accompanying report must provide the following:

- (1) Maximum and minimum delivery pressures;
- (2) Waterline profiles where slope exceeds fifteen (15) percent on any reach or where vertical fittings are proposed;
- (3) Existing and proposed physical features within ten (10) feet of the waterline, including trees, geologically unstable areas,

cliffs, ponds, ditches and other topographic features;

- (4) Pipe material, size and bedding class for all reaches of pipe, existing and proposed;
- (5) Approximate location of proposed and existing utilities within twenty (20) feet of the proposed construction;
- (6) Existing and proposed roads, sidewalk and curblines;
- (7) Right-of-way lines, easement lines, street names, one-hundred-year floodplain, benchmarks, origin of survey, basis of bearing, section, township, range and professional engineer's seal.

(b) Construction plans should be provided in the same general format as are preliminary improvement plans submitted per the subdivision procedures.

(c) As-built plans shall include all information required in the construction plans and shall provide additional or revised information on location of valves, service lines, fittings, hydrants and water main lines. As-built plans shall be stamped by a professional engineer certifying that all facilities were installed in substantial accordance with the approved plans.

(Code 1962, § 12-1-4)

Sec. 14-238. Same—Sanitary sewers.

(a) Sanitary sewer construction plans must be sufficiently complete to provide assurance of compliance with design standards. Construction plans must contain a statement that all facilities are to be installed in accordance with the Standard Specifications for Construction of Waterlines, Sanitary Sewers and Storm Drainage Facilities. Additionally, the plans or accompanying report must provide the following:

- (1) Plan and profile, bearing, distance, size and grade of each reach, of sanitary sewer and force mains showing finished ground or pavement elevation and invert and rim elevations at each manhole;
- (2) Existing and proposed lift stations with site details;

(3) Existing and proposed physical features within twenty (20) feet of the sewer line including geologically unstable areas, trees, cliffs, ponds, ditches and other topographic features;

- (4) Pipe material, size and bedding class for all reaches of pipe, existing and proposed;
- (5) Approximate location of proposed and existing utilities within twenty (20) feet of the sewer line;
- (6) Existing and proposed roads, sidewalks and curblines;
- (7) Right-of-way lines, easement lines, street names, one-hundred-year floodplain, benchmarks, origin of survey, basis of bearing, section, township, range and professional engineer's seal.

(b) Construction plans should be provided in the same general format as are preliminary improvement plans submitted per subdivision procedures.

(c) As-built plans shall include all information required in the construction plans and shall provide additional or revised information when changes in horizontal alignment exceed one (1) foot or vertical alignment exceeds one-tenth foot. If the standards are compromised or if public facilities are installed outside of public rights-of-way or easements, the as-built plans shall note the same. As-built plans shall be stamped by a professional engineer certifying that facilities were installed substantially in accordance with approved plans.

(Code 1962, § 12-1-5)

Sec. 14-239. Same—Storm sewers.

(a) Storm sewer construction plans must be sufficiently complete to provide assurance of compliance with design standards. Construction plans must contain a statement that all facilities are to be installed in accordance with Standard Specifications for Construction of Waterlines, Sanitary Sewers and Storm Drainage Facilities. Additionally, the plans or accompanying report must provide the following:

- (1) Plan and profile of storm sewer, bearing, distance, size and grade, showing original

ground, proposed finished elevation and invert elevations at each manhole, inlet or wing wall;

- (2) Design calculations of Flow (Q10, Q100) at critical points in the storm sewer, both off-site and on-site, including points of entry into the storm sewer system and points of departure from the storm sewer system;
- (3) Two-foot contours, proposed and existing;
- (4) Points of entry of flows onto the street system and direction of flow on the street system;
- (5) Inlet location, type and capacity;
- (6) Existing and proposed physical features within twenty (20) feet of the storm sewer, including geologically unstable areas, trees, cliffs, ponds, ditches and other topographic features;
- (7) Pipe material, size and bedding class for all reaches of pipe, existing and proposed.

(b) Construction plans should be provided in the same general format as are preliminary improvement plans submitted pursuant to subdivision procedures.

(c) As-built plans shall include all information required in the construction plans and shall provide additional or revised information when changes in horizontal alignment exceed one (1) foot or vertical alignment exceeds one-tenth foot. If the standards are compromised or if public facilities are installed outside of public rights-of-way or easements, the as-built plans shall note the same. As-built plans shall be stamped by a professional engineer certifying that facilities were installed substantially in accordance with approved plans. (Code 1962, § 12-1-6)

Sec. 14-240. Guarantee of improvements—Security agreements, collateral arrangements, bonds.

(a) An agreement or contract setting forth the construction plan, method of construction, and parties responsible for the construction of any public improvements, together with adequate security or collateral acceptable to the city manager, shall be required prior to the commencement

of construction of any public improvements. In addition thereto, no preliminary PUD plan or preliminary subdivision plat shall be approved until the applicant has submitted and the city manager has approved a PUD or subdivision improvements agreement guaranteeing to construct any required public improvements shown in the final PUD plan or the final subdivision plat, together with collateral which is sufficient in the judgment of the city manager to make reasonable provisions for the completion of the improvements in accordance with the design and time specifications. The types of collateral which may be used as security under this section are as follows:

- (1) Performance or property bond;
- (2) Private or public escrow agreement;
- (3) Letters of credit;
- (4) Assignments of receivables; or
- (5) Deposits of certified funds or other similar surety agreements acceptable to the city manager.

(b) The city shall not require security agreements with collateral arrangements in excess of the city engineer's estimate of the cost of public improvements. Any security agreements, collateral arrangements or bonds furnished pursuant to this section shall not expire for a period of fourteen (14) months after the date upon which construction of public improvements is to be completed pursuant to the applicable improvements agreement; provided, however, a partial release of such security or collateral may be obtained pursuant to the procedures set forth in section 14-241.

(Code 1962, § 12-1-7(A))

Sec. 14-241. Same—Release or use of collateral, security.

As public improvements are completed, the applicant may apply to the city manager for a release of part or all of the collateral or security deposited with the city; provided, however, the city manager, upon recommendation of the city engineer, shall retain a reasonable portion of such collateral, which shall not be less than fifty (50) percent thereof, during the one-year warranty pe-

riod required under the improvements agreement. Upon final inspection, approval and acceptance of the public improvements by the city engineer, the city manager, or his designated representative, shall release that portion of the collateral or security not required to secure the warranty period. If the city manager determines that any of the improvements are not constructed in substantial compliance with applicable city specifications, the city manager may, pursuant to the improvements agreement, withdraw and employ from the deposited collateral of security such funds as may be necessary to construct or repair the improvements in accordance with such specifications.
(Code 1962, § 12-1-7(B))

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Chapter 25

UTILITIES*

- Art. I. In General, §§ 25-1–25-15
- Art. II. Water, §§ 25-16–25-50
- Art. III. Sewers And Sewage Disposal, §§ 25-51–25-130
 - Div. 1. Generally, §§ 25-51–25-70
 - Div. 2. Connections, §§ 25-71–25-85
 - Div. 3. Discharge Regulations, §§ 25-86–25-110
 - Div. 4. Rates And User Charge System, §§ 25-111–25-130
- Art. IV. Utility Refund Program, §§ 25-131–25-149
- Art. V. Gas Company Facilities Regulations, §§ 25-150–25-160

*Charter reference—Local improvement bonds, Art. V, § 23.

Cross references—Administration, Ch. 2; boards, commissions and committees, Ch. 5; water commission, § 5-191; buildings and building regulations, Ch. 6; fire prevention and protection, Ch. 8; flood protection and prevention, Ch. 9; garbage and refuse, Ch. 10; health and sanitation, Ch. 11; abandoned wells, cesspools or other excavations to be filled or plugged to prevent injury, § 12-2; local public improvements, Ch. 14; development and construction standards for utilities, § 14-160 et seq.; streets, sidewalks and other public places, Ch. 21; subdivisions, Ch. 22; land use and development code, Ch. 27.

State law references—Municipal utilities, C.R.S. § 31-15-707 et seq.; public improvements, C.R.S. § 31-15-701 et seq.

ARTICLE I. IN GENERAL**Sec. 25-1. Written agreements for installations and connections.**

All parties connecting to the city water or sanitary sewer utility shall be required to execute for the benefit of the city either an implied consent agreement or a utility service agreement pursuant to which all installations and connections shall be accomplished in accordance with existing city specifications.
(Code 1962, § 12-4-6)

Secs. 25-2—25-15. Reserved.

ARTICLE II. WATER***Sec. 25-16. Restrictions, regulations established.**

Any person making connection to the water utility of the city shall be subject to the restrictions and regulations set forth in this article.
(Code 1962, § 12-4-1)

Sec. 25-17. Rates and fees generally.

All users of the city water utility shall be required to pay, as and when due, the applicable charges for water service as set forth in section 25-30 and shall also be required prior to the time of connections to the city water utility to pay the applicable water plant investment fee pursuant to the applicable schedule of fees adopted by resolution of the city council.
(Code 1962, § 12-4-2)

Sec. 25-18. General supervision.

The city manager, under the direction of the city council, shall have general control of the waterworks and sewers of the city, the management thereof and the supervision of such system.
(Code 1962, § 3-3-1)

*Cross reference—The Durango water commission created, § 5-191.

Sec. 25-19. Public works director.

The public works director, under the direction of the city manager, shall have charge of the water and sanitary sewer systems.
(Code 1962, § 3-3-2)

Sec. 25-20. Individual shutoff required for each connection.

All water users within the city as well as water users outside the city connected to the city water system shall provide each property or connection with an individual shutoff of each water consumer. The water superintendent shall notify the owner of any property not now provided with individual shutoff to have the same installed and, unless the owner shall have the work done within thirty (30) days from such notice, the work shall be performed by the superintendent and the cost thereof charged to the owner and water service shall not be initiated until such charges are paid.
(Code 1962, § 3-3-3)

Sec. 25-21. Qualified plumbers to perform work.

It shall be unlawful for any person not a duly qualified plumber to do any work in plumbing or laying or connecting pipes for the distribution of water from the water mains or connecting drains to the city sewers. It shall be unlawful for any person except the public works director or his employees to tap any water main, adjust any corporation cock, curb cock or service box cover or tap any sewer main.
(Code 1962, § 3-3-4)

Sec. 25-22. Timely commencement of work done under permit.

All work undertaken by virtue of any permit shall be done with reasonable dispatch and no work shall be done or commenced upon any public place of the city prior to the granting of a permit therefor.
(Code 1962, § 3-3-6)

Sec. 25-23. Materials furnished by city; cost.

All water users within the city as well as water users outside the city connected to the city water

system shall reimburse the city for all materials furnished to each user by the city, including, but not limited to, the tap, corporation cock and connection, curb cock, service box, water meter, meter pit, meter readout and any other materials. The applicant for water service shall pay the finance department for the cost of materials and installation prior to the connection of the water utility. All excavations for reaching the mains and for placing the curb cock and service box as well as the furnishing and laying of connecting pipes shall be done at the expense of the owner of the premises to which such pipes are placed. All service pipes shall be laid not less than four (4) feet below the established grade of any avenue, street or alley.

(Code 1962, § 3-3-7)

Sec. 25-24. Maintenance of pipes and fixtures.

(a) The owner of any premises to which water shall be conducted shall keep all fixtures and pipes from the street main to the premises, and inside the premises, in good repair. Unless the owner shall promptly repair any fixtures or pipes when notified by the public works director, the water shall be turned off and shall not be turned on again until repairs are made.

(b) The owner shall, at all times, keep the curb cock and service box in repair so that the public works director may be able to turn off the water at any time.

(Code 1962, § 3-3-8)

Sec. 25-25. Right of entry.

The public works director shall have the right to enter all private premises and buildings in which water is used to examine the pipes and fixtures and to ascertain if there is any unnecessary waste of water and to see that houses and other buildings are properly classified as to rates.

(Code 1962, § 3-3-9)

Sec. 25-26. Right to shut off water for repair, other work.

The city reserves the right to cause the water to be shut off from the mains when necessary for repairs, making connections or extensions or do-

ing any other necessary work. No claim shall be made against the city on account of shutting off the water from the mains or for the breaking of any service pipe or fixtures connected thereto.

(Code 1962, § 3-3-10)

Sec. 25-27. Compliance required.

Any person who shall lay any water or sewer pipes or introduce into or about any building or on any grounds any water drainpipes or do any plumbing work in any building or on any grounds for the purpose of connecting such pipe or plumbing work with the city water mains or sewers or of preparing them for connection or who shall make any addition to or alterations of any water pipes, fixtures or apparatus for the supplying of any premises with water or any drainpipes for conducting waste to the sewers contrary to the provisions of this article shall be deemed guilty of violation of this Code.

(Code 1962, § 3-3-11)

Sec. 25-28. Exceptions.

Nothing in this article shall be construed to prohibit any owner or occupant from repairing or replacing any faucet, either inside or outside any building, or from extending any irrigation pipes on any property where a license for irrigation has been obtained.

(Code 1962, § 3-3-12)

Sec. 25-29. Tampering with system; unauthorized use.

(a) It shall be unlawful for any person to open any fireplug or curb cock or any valve or other fixture appertaining to or connecting with the city waterworks or to turn or shut off water from any water pipe connected with the same or to turn any drain into the sanitary sewers without authority.

(b) It shall be unlawful for any person to use water from the water system of the city unless prior authorization for such shall have been obtained under and according to the terms of this article.

(Code 1962, § 3-3-13)

Sec. 25-30. Charges.

(a) *Residential.* The charges for residential water service shall consist of a monthly service charge which includes the charge for the initial two thousand (2,000) gallons of water usage for a single living unit, and four thousand (4,000) gallons of usage on residential duplexes or two-family living units. In addition thereto, a graduated volume charge shall be imposed per one thousand (1,000) gallons of water consumed above the minimum of two thousand (2,000) and four thousand (4,000) gallons respectively per billing cycle. For those customers served by more than one (1) meter, the service charge shall be applied to each meter. Monthly service charges shall be billed to each meter in use regardless of whether any quantity charge is imposed. A meter shall be considered in use so long as it is in place unless the owner or occupant of the premises to which the meter is attached has requested a temporary discontinuance of service for the reasons that (1) the water distribution system is utilized for outside irrigation purposes only; or (2) the premises to which the meter is attached will be uninhabited and therefor not in need of water service. If such service is discontinued pursuant to request, no minimum service charge shall be levied pursuant to this section until such time as service is reconnected and, as a condition of such reconnection, the owner or occupant shall pay the fees required by section 25-36. The schedule of monthly rates for residential water users shall be as follows:

<i>Consumption</i>	<i>Monthly Charge</i>
Single living unit:	
1st 2,000 gallons	\$ 5.60
Over 2,000 gallons up to 10,000 gallons (per 1,000 gallons)	1.19
Over 10,000 gallons (per 1,000 gallons)	1.49
Minimum per bill	5.60
Residential duplex:	
1st 4,000 gallons	11.20

<i>Consumption</i>	<i>Monthly Charge</i>
Over 4,000 gallons up to 12,000 gallons (per 1,000 gallons)	1.19
Over 12,000 gallons (per 1,000 gallons)	1.49
Minimum per bill	11.20

For purposes of this article, living unit as to residential water user shall be defined and limited to a dwelling or structure used for residential purposes and containing one (1) family or group of individuals living independently of each other in separate apartments. Living units as residential dwellings containing three (3) families or more or three (3) apartments or more shall be classified as industrial and commercial for purposes of this article.

(b) *Industrial and commercial.* Charges for industrial and commercial water service shall consist of a monthly service charge which includes the charge for the initial two thousand (2,000) gallons of water usage and, in addition thereto, there shall be a graduated volume charge per one thousand (1,000) gallons of water consumed above the minimum of two thousand (2,000) gallons per billing cycle. Monthly service charges shall be billed to each meter in use regardless of whether any quantity charge is made. A meter shall be considered in use so long as it is in place. Rates for industrial and commercial water consumption inside the city limits are as follows:

<i>Consumption</i>	<i>Monthly Charge</i>
1st 2,000 gallons	\$ 11.40
Over 2,000 gallons up to 100,000 gallons (per 1,000 gallons)	1.19
Over 100,000 gallons (per 1,000 gallons)	1.49
Minimum per bill	11.40

Rates for water provided to the Animas Water Company shall be as follows:

<i>Consumption</i>	<i>Monthly Charge</i>
1st 2,000 gallons	\$ 11.40

<i>Consumption</i>	<i>Monthly Charge</i>
Over 2,000 gallons up to 6,000,000 gallons (per 1,000 gallons)	1.19
Over 6,000,000 gallons (per 1,000 gallons)	1.49
Minimum per bill	11.40

Rates for water provided to Fort Lewis College shall be as follows:

<i>Consumption</i>	<i>Monthly Charge</i>
1st 2,000 gallons	\$ 11.40
Over 2,000 gallons up to 2,500,000 gallons (per 1,000 gallons)	1.19
Over 2,500,000 gallons (per 1,000 gallons)	1.49
Minimum per bill	11.40

(c) *Raw water usage.* Unless otherwise specified by contractual agreement, all users of raw or untreated water from the city water utility shall pay a volume charge of seventy-four cents (\$0.74) per one thousand (1,000) gallons of consumption.

(d) *Outside city users.*

(1) Users of the city's water utility located outside the corporate limits of the City of Durango but within the city's service area as defined in the comprehensive plan shall be classified as residential or nonresidential, and if such users are in compliance with the terms and provisions of Chapter 25 of this Code, including specifically, but not by way of limitation, section 25-17 thereof, or are receiving water service pursuant to a contract entered into with the City of Durango consistent with the water provider policy previously adopted by the city council, such users shall pay the same rates and charges as are paid by residential or nonresidential users located within the city for the same usage and consumption as set forth pursuant to subsections (a), (b) and (c) of this section, respectively. Absent such compliance or contractual agreement, outsider city users shall pay rates in existence prior to the repeal and reenactment of this subsection and such preexisting rates

shall continue in effect unless and until specifically modified by action of the city council.

In addition, outside city users shall pay such additional charges as the city council may specifically determine, upon recommendation of the city engineer, to cover additional costs of providing delivery of water if such additional costs are clearly identifiable, relate solely to the provision of water to outside city users, and are in excess of comparable costs of delivery to similarly situated users of the water utility within the city.

- (2) Users of the city's water utility located outside the city's service area as initially defined in the planning and service area boundary map initially adopted through the 1985 Comprehensive Plan for the City of Durango shall be required to pay rates and charges as determined by contract approved by the city council pursuant to which such water service is to be provided. Nothing within this subsection shall obligate the city to provide water service to users located outside the city's planning and service area boundaries as defined in the 1985 Comprehensive Plan if the city determines that the provision of such service is not in the best interests of the city and existing users of the city's water utility.
- (3) No outside city water connection shall be made without prior special approval of the city council.

(Code 1962, § 3-3-14; Ord. No. 1987-4, § 1, 3-3-87; Ord. No. 1995-18, § 1, 7-18-95)

Editor's note—The "preexisting rates" referred to in subsection (c)(1) hereinabove, and as formerly set out in subsection (c)(1) and (2), constituted a "bimonthly charge equal to one hundred fifty (150) percent of the charges levied against residential water users within the city" for residential users, and a "monthly charge equal to one hundred fifty (150) percent of the charges levied against nonresidential water users within the city" for nonresidential users.

Sec. 25-31. Meters.

(a) All connections to the city water distribution system shall be metered. Each meter shall be of sufficient size to ensure that the peak demand

required does not exceed eighty (80) percent of the recommended meter capacity as set forth by the American Water Works Association.

(b) All meters, meter pits and covers, meter risers, remote reads, generators and all other appurtenances shall be furnished by the city at the expense of the property owner. The city shall maintain and repair all meters and the meters shall remain the property of the city. All meters shall be installed by the owner of the property at his own expense on the premises where the water is to be furnished and all installation of water meters shall be under the direction and supervision of the public works director.

(c) It shall be unlawful for any person, except for the public works director or someone authorized by him, to unlock, interfere with or molest any meter belonging to the city.

(d) All meters installed must be put in an accessible place for reading and servicing. The building inspector, public works director or city manager shall have authority, after thirty (30) days' notice to cause to be relocated any meters that are in an inaccessible location. The building inspector, public works director or city manager shall also have the authority to designate the location of any meter installed.

(Code 1962, § 3-3-15)

Sec. 25-32. Water plant investment fee.

(a) Any applicant desiring to take and use water from the water utility of the city shall pay to the city through the office of finance a water plant investment fee pursuant to the schedule of plant investment fees then in effect pursuant to resolution duly adopted by the city council. No water connection shall be made to the city water utility until such time as the plant investment fee has been paid. The plant investment fees authorized by resolution of the city council shall not apply to a water connection to the city water utility exclusively for the purpose of providing a sprinkling system for fire protection within a structure.

(b) Plant investment fees for water users connected to the city water utility from points outside the municipal boundaries of the city shall be

payable directly to the city and shall be payable prior to any connection to the city water utility. (Code 1962, § 3-3-15)

Sec. 25-33. Restriction on use under shortage conditions.

Whenever, in the opinion of the city manager, a shortage of the water supply exists or is from any cause threatened, the city manager may, by order published in such daily paper as may be published at such time in the city, prohibit the use of water for irrigation, shorten the hours for irrigation, change the hours of irrigation, provide for the irrigation of different parts of the city on different days, or otherwise, until the next meeting of the city council. At the council meeting, such order may be confirmed, continued or annulled by the city council, by resolution. Such resolution shall be published in the same manner as the original order. (Code 1962, § 3-3-17)

Sec. 25-34. Contract in name of property owner.

All contracts for the use of water shall be made in the name of the owner of the property. The charge shall be a lien on the property where water is used. (Code 1962, § 3-3-18)

Sec. 25-35. Delinquent accounts—Notice.

If any assessments for water rents, sanitation or sewer shall remain unpaid thirty (30) days after the due date for the statement for such services, the city may issue a notice in substantially the following form:

"Your water, sanitation and sewer assessment for _____ (address or property description) _____ has remained unpaid for thirty (30) days after the due date of the original statement of account sent to you. If you dispute the accuracy of this bill, you must request in writing a hearing with the Finance Director of the City of Durango, which written request should be mailed or delivered to the Finance Director of the City of Durango, 949 East Second Avenue, Durango, Colorado 81301,

no later than seven (7) days from the receipt of this notice. If you fail to make written request for a hearing concerning a disputed account as herein provided and further fail to pay the full amount of \$_____ within ten (10) days after the date of this notice to you, your service will be discontinued. If service is discontinued, service will not be resumed until the full amount due plus a service charge for resumption of service has been paid. The service charge will be fifteen dollars (\$15.00) if reconnection to the utility occurs during normal business hours or thirty dollars (\$30.00) if reconnection occurs after normal business hours or during weekends."

(Code 1962, § 3-3-19; Ord. No. 1989-18, § 1, 10-17-89; Ord. No. 1991-20, § 3, 1-7-92)

Sec. 25-36. Same—Discontinuance of service.

(a) If the notice described in section 25-35 is sent and full payment is not made within ten (10) days after the date of such notice and no request for a hearing concerning disputed billing is made by the recipient of such notice, the water service, sewer service or sanitation service for which the billing is made shall be discontinued until the full amount due to the city, including the applicable service charge for reconnection of service, has been paid.

(b) Nothing in this section shall be construed as to prevent the city from using other lawful means of collecting the assessments referred to in this article.

(Code 1962, § 3-3-20; Ord. No. 1989-18, § 2, 10-17-89)

Sec. 25-37. Installation of new lines by subdivider; reimbursement.

When a subdivider or other person doing the construction finds it necessary to construct sewer lines or waterlines through undeveloped areas or areas not served by sewer lines or waterlines in order to serve a platted subdivision or other property, the entire cost of such sewer line or waterline shall be paid by the subdivider or person constructing the same unless oversize main provisions are applicable. At the time of annexation,

or as the property abutting such sewer or ^{water} sewer line is developed and connections are made to the same, the city may collect a charge per front foot based upon the original construction cost and, if so collected, shall reimburse the original subdivider or constructor to the extent of the collection so made; provided, however, that in no event shall such reimbursement exceed the total cost of the sewer line or waterline. A subdivider's or constructor's right to reimbursement under the provisions of this section shall terminate seven (7) years after execution of the sewer line or waterline extension contract.
(Code 1962, § 3-3-21)

Sec. 25-38. Delinquent charges; collection by county.

Pursuant to the authority of C.R.S., section 31-20-105, the city council does hereby elect to certify to the county treasurer for collection of any and all delinquent water service charges due and payable to the city, to be collected by the county treasurer and paid over to the city in the same manner as ad valorem real property taxes are authorized to be collected pursuant to C.R.S., Title 31.
(Ord. No. 1991-20, § 1, 1-7-20)

Secs. 25-39—25-50. Reserved.

ARTICLE III. SEWERS AND SEWAGE DISPOSAL

DIVISION 1. GENERALLY

Sec. 25-51. Definitions.

Unless the context specifically indicates otherwise, the meaning of terms used in this article shall be as follows:

B.O.D. (denoting biochemical oxygen demand) means the quantity of oxygen utilized in the biochemical oxidation of organic matter under standard laboratory procedure in five (5) days at twenty (20) degrees Celsius, expressed in milligrams per liter (mg/l).

Building drain means that part of the lowest horizontal piping of a drainage system which receives the discharge from soil, waste and other drainage pipes inside the walls of the building and conveys it to the building sewer, beginning five (5) feet (1.5 meters) outside the inner face of the building wall.

Building sewer means the extension from the building drain to the public sewer or other place of disposal.

Combined sewer means a sewer receiving both surface and runoff waters and sewage.

Director means the director of public works of the city or his authorized representative.

Garbage means solid wastes from the domestic and commercial preparation, cooking and dispensing of food, and from the handling, storage and sale of produce.

Industrial wastes means the liquid wastes from industrial manufacturing processes, trade or business as distinct from sanitary sewage.

Natural outlet means any outlet into a watercourse, pond, ditch, lake or other body of surface water or groundwater.

pH means the logarithm of the reciprocal of the weight of hydrogen ions in grams per liter of solution.

Properly shredded garbage means the wastes from the preparation, cooking and dispensing of food that have been shredded to such a degree that all particles will be carried freely under the flow conditions normally prevailing in public sewers, with no particle greater than one-half inch (1.27 centimeters) in any dimension.

Public sewer means a sewer in which all owners of abutting properties have equal rights, and is controlled by public authority.

Sanitary sewer means a sewer which carries sewage and to which storm waters, surface waters, and groundwaters are not intentionally admitted.

Sewerage means a combination of the water-carried wastes from residences, business buildings,

institutions and industrial establishments, together with such groundwaters, surface waters, and storm waters as may be present.

Sewage treatment plant means any arrangement of devices and structures used for treating sewage.

Sewage works means all facilities for collecting, pumping, treating and disposing of sewage.

Sewer means a pipe or conduit for carrying sewage.

Slug means any discharge of water, sewage or industrial waste which in concentration of any given constituent or in quantity of flow exceeds for any period of duration longer than fifteen (15) minutes more than five (5) times the average twenty-four-hour concentration or flows during normal operation.

Storm drain means a sewer which carries storm and surface waters and drainage, but excludes

sewage and industrial wastes, other than unpolluted cooling water.

Suspended solids means solids that either float on the surface of, or are in suspension in, water, sewage or other liquids, and which are removable by laboratory filtering.

Watercourse means a channel in which a flow of water occurs, either continuously or intermittently.

(Code 1962, § 8-5-1)

Cross reference—Definitions and rules of construction generally, § 1-2.

Sec. 25-52. Unlawful deposits of objectionable wastes; discharges into natural outlets.

(a) It shall be unlawful for any persons to place, deposit or permit to be deposited in any unsanitary manner on public or private property within the jurisdiction of the city any human or animal excrement, garbage or other objectionable waste.

(b) It shall be unlawful to discharge to any natural outlet within the jurisdiction of the city any sewage or other polluted waters, except where suitable treatment has been provided in accordance with subsequent provisions of this article.
(Code 1962, § 8-5-2(A), (B))

Sec. 25-53. Damaging, tampering with sewage works.

No unauthorized person shall maliciously, willfully or negligently break, damage, destroy, uncover, deface, or tamper with any structure, appurtenance or equipment which is part of the sewage works. Any person violating this provision shall be subject to immediate arrest under charge of disorderly conduct.
(Code 1962, § 8-5-6)

Sec. 25-54. Inspections; sampling; testing.

(a) The director of public works and other duly authorized employees of the city bearing proper credentials and identification shall be permitted to enter all properties for the purposes of inspection, observation, measurement, sampling and testing in accordance with the provisions of this article. The director shall have no authority to in-

quire into any processes including metallurgical, chemical, oil, refining, ceramic, paper or other industries beyond that point having a direct bearing on the kind and source of discharge to the sewers or waterways or facilities for waste treatment.

(b) While performing the necessary work on private properties referred to in subsection (a) of this section, the director shall observe all safety rules applicable to the premises established by the company. The company shall be held harmless for injury or death to the city employees and the city shall indemnify the company against loss or damage to its property by city employees and against liability claims and demands for personal injury or property damage asserted against the company and growing out of the gauging and sampling operation, except as such may be caused by negligence or failure of the company to maintain safe conditions as required in section 25-93.

(c) The director and other duly authorized employees of the city bearing proper credentials and identification shall be permitted to enter all private properties through which the city holds a duly negotiated easement for the purposes of, but not limited to, inspection, observation, measurement, sampling, repair and maintenance of any portion of the sewage works lying within such easement. All entry and subsequent work, if any, on such easement, shall be done in full accordance with the terms of the duly negotiated easement pertaining to the private property involved.
(Code 1962, § 8-5-7)

Sec. 25-55. Trailer coaches.

(a) No trailer coaches shall be parked in any trailer coach park unless they have connections to city water and city sanitary sewage facilities; provided however, that if either city water or city sanitary sewage facilities are not available, then other sources of water and sewage disposal facilities may be used.

(b) Such sources of water and method of disposal of sanitary sewage shall, however, be approved by the building inspector and the county and state prior to the time that any license is issued. There shall be no change in methods of

supplying water or sanitary sewer facilities without first obtaining the approval of the county and the building inspector.

(c) No connection to city water and city sanitary sewage facilities shall be necessary in any instance where the trailer court accommodates trailer coaches which are not equipped with facilities for fresh water and do not have built-in sanitary facilities which can be connected to a sanitary sewer. This section is for the purpose of accommodating tourist campers and vacation trailers, usually, but not always self-propelled and commonly used for vacation traveling, and not occupied on a permanent basis; and provided further, that trailer courts or trailer parks accommodating only the above-described camper trailers shall not allow any trailer coach with built in sanitary facilities which can be connected to the city water and sewage facilities to park in this type of trailer court. The license for this type of trailer coach park shall be designated as a second class license.

(Code 1962, § 5-6-6)

Sec. 25-56. Applicability to connectors.

Any person making connection to the sewer utility of the city shall be subject to the restrictions and regulations set forth in this article.

(Code 1962, § 12-4-3)

Sec. 25-57. Rates and fees generally.

All users of the city sewer utility shall be required to pay, as and when due, the applicable charges for sewer service as set forth in section 25-114 and shall also be required prior to the time of connection to the city sewer utility to pay the applicable sewer plant investment fees pursuant to the applicable schedule of fees adopted by resolution of the city council. (Code 1962, § 12-4-4)

Sec. 25-58. Violations; penalties.

(a) Any person found to be violating any provision of this article except section 25-53 shall be served by the city with written notice stating the nature of the violation and providing a reasonable time limit for the satisfactory correction thereof.

The offender shall, within the period of time stated in such notice, permanently cease all violation.

(b) Any person who shall continue any violation beyond the time limit provided for in subsection (a) shall be guilty of a misdemeanor, and on conviction thereof shall be fined in an amount not exceeding three hundred dollars (\$300.00) for each violation. Each twenty-four-hour period in which any such violation shall continue shall be deemed a separate offense.

(c) Any person violating any of the provisions of this article shall become liable to the city for any expense, loss or damage occasioned the city by reason of such violation.

(Code 1962, § 8-5-8)

Secs. 25-59—25-70. Reserved.

DIVISION 2. CONNECTIONS

Sec. 25-71. Required.

(a) Except as provided in this division, it shall be unlawful to construct or maintain any privy, privy vault, septic tank, cesspool or other facility intended or used for the disposal of sewage.

(b) The owners of all houses, buildings or properties used for human employment, recreation or other purposes, situated within the city and abutting on any street, alley or right-of-way in which there is now located or may in the future be located a public sanitary or combined sewer of the city, is hereby required at his expense to install suitable toilet facilities therein, and to connect such facilities directly with the proper public sewer in accordance with the provisions of this division, within ninety (90) days after date of official notice to do so, provided that such public sewer is within four hundred (400) feet of the property line.

(Code 1962, § 8-5-2(C), (D))

Sec. 25-72. Private sewage disposal systems.

(a) Where a public sanitary or combined sewer is not available under the provisions of subsection (b) of section 25-71, the building sewer shall be connected to a private sewage disposal system complying with the provisions of this section.

(b) Before commencement of construction of a private sewage disposal system, the owner shall first obtain a written permit signed by the director. The application for such permit shall be made on a form furnished by the city, which the applicant shall supplement by any plans, specifications and other information as are deemed necessary by the director. A permit and inspection fee of ten dollars (\$10.00) shall be paid to the city at the time the application is filed.

(c) A permit for a private sewage disposal system shall not become effective until the installation is completed to the satisfaction of the director. He shall be allowed to inspect the work at any stage of construction and, in any event, the applicant for the permit shall notify the director when the work is ready for final inspection and before any underground portions are covered. The inspection shall be made within forty-eight (48) hours of the receipt of notice by the director.

(d) The type, capacities, location and layout of a private sewage disposal system shall comply with all recommendations of the state water quality control commission. No permit shall be issued for any private sewage disposal system employing subsurface soil absorption facilities where the area of the lot is less than three (3) acres. No septic tank or cesspool shall be permitted to discharge to any natural outlet.

(e) At such time as a public sewer becomes available to a property served by a private sewage disposal system, as provided in subsection (d), a direct connection shall be made to the public sewer in compliance with this division. Any such septic tanks, cesspools and similar private sewage disposal facilities shall be abandoned and filled with suitable material.

(f) The owner shall operate and maintain the private sewage disposal facilities in a sanitary manner at all times, at no expense to the city.

(g) No statement contained in this section shall be construed to interfere with any additional requirements that may be imposed by the state water quality control commission.

(h) When a public sewer becomes available, the building sewer shall be connected to such sewer

within ten (10) days and the private sewage disposal system shall be cleaned of sludge and filled with clean bankrun gravel or dirt.

(Code 1962, § 8-5-3)

Sec. 25-73. Permits; requirements.

(a) No unauthorized person shall uncover, make any connections with or opening into, use, alter or disturb any public sewer or appurtenance thereof without first obtaining a written permit from the director.

(b) There shall be two (2) classes of building sewer permits:

- (1) For residential and commercial service; and
- (2) For establishments producing industrial wastes.

In either case, the owner or his agent shall make application on a special form furnished by the city. The permit application shall be supplemented by any plans, specifications or other information considered pertinent in the judgment of the director. A permit and inspection fee of ten dollars (\$10.00) for a residential or commercial building sewer permit shall be paid to the city at the time the application is filed. A permit and inspection fee of twenty-five dollars (\$25.00) for establishments producing industrial waste shall be paid to the city at the time the application is filed.

(c) All costs and expense incident to the installation and connection of the building sewer shall be borne by the owner. The owner shall indemnify the city from any loss or damage that may directly or indirectly be occasioned by the installation of the building sewer.

(d) A separate and independent building sewer shall be provided for every building; except where one (1) building stands at the rear of another or an interior lot and no private sewer is available or can be constructed to the rear building through an adjoining alley, court yard or driveway, the building sewer from the front building may be extended to the rear building and the whole considered as one (1) building sewer.

(e) Old building sewers may be used in connection with new buildings only when they are found,

on examination and tested by the director, to meet all requirements of this article.

(f) The size, slope, alignment, materials of construction of a building sewer and the methods to be used in excavating, placing of the pipe, jointing, testing and backfilling the trench, shall all conform to the requirements of the city building and plumbing codes or other applicable rules and regulations of the city. In the absence of code provisions or in amplification thereof, the materials and procedures set forth in appropriate specifications of the latest edition of the A.S.T.M. and W.P.C.F. manual of practice no. 9 shall apply.

(g) Whenever possible, the building sewer shall be brought to the building at an elevation below the basement floor. In all buildings in which any building drain is too low to permit gravity flow to the public sewer, sanitary sewage carried by such building drain shall be lifted by an approved means and discharged to the building sewer.

(h) No person shall make connection of roof downspouts, interior and exterior foundation drains, areaway drains or other sources of surface runoff or groundwater to a building sewer or building drain which in turn is connected directly or indirectly to a public sanitary sewer.

(i) The connection of the building sewer into the public sewer shall conform to the requirements of the building and plumbing code or other applicable rules and regulations of the city, or the procedures set forth in appropriate specifications of the latest edition of the A.S.T.M. and the W.P.C.F. manual of practice no. 9. All such connections shall be made gastight and watertight. Any deviation from the prescribed procedures and materials must be approved by the director before installation.

(j) The applicant for the building sewer permit shall notify the director when the building sewer is ready for inspection and connection to the public sewer. The connection shall be made under the supervision of the director.

(k) All excavations for building sewer installation shall be adequately guarded with barricades and lights so as to protect the public from hazard. Streets, sidewalks, parkways and other public prop-

erty disturbed in the course of the work shall be restored in a manner satisfactory to the city. (Code 1962, § 8-5-4)

Secs. 25-74—25-85. Reserved.

DIVISION 3. DISCHARGE REGULATIONS

Sec. 25-86. Generally.

No person shall discharge or cause to be discharged any storm water, surface water, groundwater, roof runoff, subsurface drainage including interior and exterior foundation drains, uncontaminated cooling water or unpolluted industrial process waters to any sanitary sewer. (Code 1962, § 8-5-5(A))

Sec. 25-87. Storm water; unpolluted drainage; industrial cooling or process waters.

Storm water and all other unpolluted drainage shall be discharged to such sewers as are specifically designated as combined sewers or storm sewers, or to a natural outlet approved by the director of public works. Industrial cooling water or unpolluted process waters may be discharged on approval of the superintendent of water and sewers, to a storm sewer, combined sewer, or natural outlet. (Code 1962, § 8-5-5(B))

Sec. 25-88. Prohibited discharges—Generally.

No person shall discharge or cause to be discharged any of the following described waters or wastes to any public sewers:

- (1) Any gasoline, oil, benzene, naphtha, fuel oil or other flammable or explosive liquid, solid or gas;
- (2) Any waters or wastes containing toxic or poisonous solids, liquids or gases in sufficient quantity, either singly or by interaction with other wastes, to injure or interfere with any sewage treatment process, constitute a hazard to humans or animals, create a public nuisance or create any hazard in the receiving waters of the sewage

treatment plant, including but not limited to cyanides in excess of two (2) mg/l as CN in the wastes as discharged to the public sewer;

- (3) Any waters or wastes having a pH lower than 5.5, or having any other corrosive property capable of causing damage or hazard to structures, equipment and personnel of the sewage works;
 - (4) Solid or viscous substances in quantities or of such size capable of causing obstruction to the flow in sewers or other interference with the proper operation of the sewage works such as, but not limited to, ashes, cinders, sand, mud, straw, shavings, metal, glass, rags, feathers, tar, plastics, wood, whey, buttermilk, carcasses or hides of dead animals or fowl, unground garbage, whole blood, paunch manure, hair and fleshings, entrails, paper dishes, cups, milk containers, etc., either whole or ground by garbage grinders.
- (Code 1962, § 8-5-5(C))

Sec. 25-89. Same—Harmful substances.

(a) No person shall discharge or cause to be discharged the following described substances, materials, waters or wastes if it appears likely in the opinion of the director that such wastes can harm either the sewers, sewage treatment process or equipment, have an adverse effect on the receiving stream, or can otherwise endanger life, limb, public property or constitute a nuisance. In forming his opinion as to the acceptability of these wastes, the director will give consideration to such factors as the quantities of subject wastes in relation to flows and velocities in the sewers, materials of construction of the sewers, nature of the sewage treatment process, capacity of the sewage treatment plant, degree of treatability of wastes in the sewage treatment plant and other pertinent factors. The prohibited substances are:

- (1) Any liquid or vapor having a temperature higher than one hundred fifty (150) degrees Fahrenheit (sixty-five (65) degrees Celsius);
- (2) Any water or wastes containing fats, wax, grease or oils, whether emulsified or not, in excess of one hundred (100) mg/l or con-

taining substances which may solidify or become viscous at temperatures between thirty-two (32) degrees and one hundred fifty (150) degrees Fahrenheit (zero (0) and sixty-five (65) degrees Celsius);

- (3) Any garbage that has not been properly shredded. The installation and operation of any garbage grinder equipped with a motor of three-fourths horsepower (0.76 hp metric) or greater shall be subject to the review and approval of the director;
- (4) Any waters or wastes containing strong acid iron pickling wastes or concentrated plating solutions whether neutralized or not;
- (5) Any waters or wastes containing iron, chromium, copper, zinc and similar objectionable or toxic substances, or wastes exerting an excessive chlorine requirement, to such degree that any such material received in the composite sewage at the sewage treatment works exceeds the limits established by the director for such materials;
- (6) Any waters or wastes containing phenols or other taste- or odor-producing substances, in such concentrations exceeding limits which may be established by the director as necessary, after treatment of the composite sewage, to meet the requirements of state, federal or other public agencies of jurisdiction for such discharge to the receiving waters;
- (7) Any radioactive wastes or isotopes of such half-life or concentration as may exceed limits established by the director in compliance with applicable state or federal regulations;
- (8) Any waters or wastes having a pH in excess of 9.5;
- (9) Materials which exert or cause:
 - a. Unusual concentrations of inert suspended solids such as, but not limited to, fuller's earth, lime slurries and lime residues or of dissolved solids such as, but not limited to, sodium chloride or sodium sulfate;

- b. Excessive discoloration, such as, but not limited to, dye wastes and vegetable tanning solutions;
- c. Unusual BOD, chemical oxygen demand (COD), or chlorine requirements in such quantities as to constitute a significant load on the sewage treatment works;
- d. Unusual volume of flow or concentrations of wastes constituting slugs as defined in this article;

(10) Waters or wastes containing substances which are not amenable to treatment or reduction by the sewage treatment processes employed or are amenable to treatment only to such degree that the sewage treatment plant effluent cannot meet the requirements of other agencies having jurisdiction over discharge to the receiving waters;

(11) Any waters or wastes having:

- a. A five (5) day BOD greater than three hundred (300) parts per million by weight;
- b. More than three hundred (300) parts per million by weight of suspended solids;
- c. An average daily flow greater than two (2) percent of the average sewage flow of the city,

shall be subject to the review of the director.

(b) Where necessary in the opinion of the director, the owner shall provide, at his expense, such preliminary treatment as may be necessary to:

- (1) Reduce the biochemical oxygen demand to three hundred (300) parts per million by weight;
- (2) Reduce the suspended solids to three hundred (300) parts per million by weight; or
- (3) Control the quantities and rates of discharge of such waters or wastes.

(c) Plans, specifications, and any other pertinent information relating to proposed preliminary treatment facilities shall be submitted for the approval of the director and no construction of such facilities shall be commenced until such approvals are obtained in writing.

(Code 1962, § 8-5-5(D))

Sec. 25-90. Pretreatment, equalization of deleterious waste flows.

(a) If any waters or wastes are discharged or are proposed to be discharged to the public sewers, which waters contain the substances or possess the characteristics enumerated in section 25-89 and which, in the judgment of the director, may have a deleterious effect upon the sewage works, process, equipment or receiving waters, or which otherwise create a hazard to life to constitute a public nuisance, the director may:

- (1) Reject the wastes;
- (2) Require pretreatment to an acceptable condition for discharge to the public sewers;
- (3) Require control over the quantities and rates of discharge;
- (4) Require payment to cover the added cost of handling and treating the wastes not covered by existing taxes or sewer charges under the provisions of section 25-95.

(b) If the director permits the pretreatment or equalization of waste flows, the design and installation of the plants and equipment shall be subject to the review and approval of the director, and subject to the requirements of all applicable codes, ordinances and laws.

(Code 1962, § 8-5-5(E))

Sec. 25-91. Maintenance of pretreatment equalizing facilities.

Where preliminary treatment or flow-equalizing facilities are provided for any waters or wastes, they shall be maintained continuously in satisfactory and effective operation by the owner at his expense.

(Code 1962, § 8-5-5(G))

Sec. 25-92. Interceptors.

Grease, oil and sand interceptors shall be provided when, in the opinion of the director of public works, they are necessary for the proper handling of liquid wastes containing grease in excessive amounts, or any flammable wastes, sand or other harmful ingredients; except that such interceptors shall not be required for private living quar-

ters or dwelling units. All interceptors shall be of a type and capacity approved by the director and shall be located as to be readily and easily accessible for cleaning and inspection.

(Code 1962, § 8-5-5(F))

Sec. 25-93. Control manholes.

When required by the director of public works, the owner of any property serviced by a building sewer carrying industrial wastes shall install a suitable control manhole together with such necessary meters and other appurtenances in the building sewer to facilitate observation, sampling, and measurement of the wastes. Such manhole, when required, shall be accessibly and safely located and shall be constructed in accordance with plans approved by the director. The manhole shall be installed by the owner at his expense and shall be maintained by him so as to be safe and accessible at all times.

(Code 1962, § 8-5-5(H))

Sec. 25-94. Measurements, tests, analyses.

All measurements, tests and analyses of the characteristics of waters and wastes to which reference is made in this article shall be determined in accordance with the latest edition of "Standard Methods for the Examination of Water and Wastewater," published by the American Public Health Association, and shall be determined at the control manhole provided, or upon suitable samples taken at such control manhole. If no special manhole has been required, the control manhole shall be considered to be the nearest downstream manhole in the public sewer to the point at which the building sewer is connected. Sampling shall be carried out by customarily accepted methods to reflect the effect of constituents upon the sewage works and to determine the existence of hazards to life, limb and property. (The particular analyses involved will determine whether a twenty-four-hour composite of all outfalls of a premise is appropriate or whether a grab sample or samples should be taken. Normally, but not always, BOD and suspended solids analyses are obtained from twenty-four-hour composites of all outfalls whereas pH's are determined from periodic grab samples).

(Code 1962, § 8-5-5(I))

Sec. 25-95. Agreements between city and industrial concerns.

No statement contained in this division shall be construed as preventing any special agreement or arrangement between the city and any industrial concern whereby an industrial waste of unusual strength or character may be accepted by the city for treatment, subject to payment therefor, by the industrial concern.

(Code 1962, § 8-5-5(J))

Secs. 25-96—25-110. Reserved.

DIVISION 4. RATES AND USER CHARGE SYSTEM*

Sec. 25-111. Definitions.

Unless the context specifically indicates otherwise, the meaning of terms used in this division shall be as follows:

Normal domestic wastewater means wastewater that has a BOD concentration of not more than three hundred (300) mg/l and a suspended solids (SS) concentration of not more than three hundred (300) mg/l. Normal domestic wastewater is considered to have a concentration which may generally range from approximately one hundred twenty-five (125) to three hundred (300) mg/l of both BOD and SS.

Operation and maintenance means all expenditures during the useful life of the treatment works for materials, labor, utilities and other items which are necessary for managing and maintaining the sewage works to achieve the capacity and performance for which such works were designed and constructed.

Replacement means expenditures for obtaining and installing equipment, accessories or appurtenances which are necessary during the useful life of the treatment works to maintain the capacity and performance for which such works were designed and constructed. The term "operation and maintenance" includes replacement.

*Cross reference—Finance, Ch. 2, art. V.

State law reference—Sewer rates; outside area of jurisdiction, C.R.S. § 31-35-701 et seq.

Residential contributor means dwellings or structures used for residential purposes and that contain no more than two (2) families or groups of individuals living independently of each other in separate apartments. Residential dwellings containing three (3) families or more or three (3) apartments or more shall be classified as industrial and commercial for purposes of this division.

SS (denoting suspended solids) means solids that either float on the surface of or are in suspension in water, sewage or other liquids and which are removable by laboratory filtering.

Treatment works means any devices and systems for the storage, treatment, recycling and reclamation of municipal sewage, domestic sewage or liquid industrial wastes. These include intercepting sewers, outfall sewers, sewage collection systems, individual systems, pumping, power and other equipment and their appurtenances; extensions improvement, remodeling, additions and alterations thereof; elements essential to provide a reliable recycled supply such as standby treatment units and clear well facilities; and any works, including site acquisition of the land that will be an integral part of the treatment process or is used for ultimate disposal of residues resulting from such treatment; or any other method or system of preventing, abating, reducing, storing, treating, separating or disposing of municipal waste or industrial waste, including waste in combined stormwater and sanitary sewer systems.

Useful life means the estimated period during which a treatment works will be operated.

User charge means that portion of the total wastewater service charge which is levied in a proportional and adequate manner for the cost of operation, maintenance and replacement of the wastewater treatment works.

Water meter means a water volume measuring and recording device, furnished or installed by the city.

(Code 1962, § 8-5A-2)

Sec. 25-112. Purpose.

It is determined and declared to be necessary and conducive to the protection of the public

health, safety, welfare and convenience of the city to collect charges from all users who contribute wastewater to the city's treatment works. The proceeds of such charges so derived will be used for the purpose of operation and maintenance and other related costs as determined by the city council for such public wastewater treatment works.

(Code 1962, § 8-5A-1)

Sec. 25-113. User charge system.

The user charge system shall generate adequate annual revenues to pay costs of annual operation and maintenance including replacement and other related sewer system costs which the city may determine by ordinance to be paid by the user charge system. That portion of the total user charge which is designated for operation and maintenance including replacement of the treatment works shall be established by this division. (Code 1962, § 8-5A-3)

Sec. 25-114. Service rates; surcharge.

(a) *Use determined by water meter.* Each user shall pay for the services provided by the city based on his use of the treatment works as determined by water meters acceptable to the city.

(b) *Residential contributors.* For residential contributors, a monthly user charge shall consist of a service charge as well as a volume charge which will be based on water consumed during a full billing period occurring during the months of January and February. If a residential contributor has not established a consumption level during the months of January and February, his monthly volume charge shall be the median volume charge of all other residential contributors.

(c) *Industrial and commercial contributors.* For industrial and commercial contributors, monthly user charges shall consist of a service charge and a volume charge based on water used during the current month. If a commercial or industrial contributor has a consumptive use of water, or in some other manner uses water which is not returned to the wastewater collection system, the volume charge for that contributor may be based on a wastewater meter or separate meter in-

stalled and maintained at the contributor's expense, or any other method acceptable to the city.

(1) *Charges.* The following are the charges:

<i>Residential</i>	<i>User charge portion</i>	<i>Capital charge portion</i>	<i>Total charge</i>
<i>Inside city user:</i>			
<i>Service charge (per bill):</i>			
One living unit	\$ 1.24	\$ 1.01	\$ 2.25
Two living units	2.48	2.02	4.50
<i>Volume charge (per 1,000 gallons)</i>			
	0.94	0.74	1.68
<i>Minimum charge (per bill):</i>			
One living unit			5.61
Two living units			11.22
<i>Outside city user:</i>			
<i>Service charge (per bill):</i>			
One living unit	1.24	3.26	4.50
Two living units	2.48	6.52	9.00
<i>Volume charge (per 1,000 gallons)</i>			
	0.94	2.42	3.36
<i>Minimum charge (per bill):</i>			
One living unit			11.22
Two living units			22.44
<i>Industrial and Commercial</i>			
<i>Inside city user:</i>			
<i>Service charge (per bill)</i>			
	2.48	2.02	4.50
<i>Volume charge (per 1,000 gallons)</i>			
	0.94	0.74	1.68
<i>Minimum charge (per bill)</i>			
			7.68
<i>Outside city user:</i>			
<i>Service charge (per bill)</i>			
	2.48	6.52	9.00
<i>Volume charge (per 1,000 gallons)</i>			
	0.94	2.42	3.36
<i>Minimum charge (per bill)</i>			
			15.72

- (2) For purposes of this division, living unit as to residential sewer users shall be defined and limited to a dwelling or structure used for residential purposes and containing one (1) family or group of individuals living independently of each other in separate apartments. Living units as residential dwellings containing three (3) families or more, or three (3) apartments or more, shall be classified as nonresidential for purposes of this division.
- (3) For those contributors who contribute wastewater, the strength of which is greater than

the upper limit of normal domestic sewage, a surcharge in addition to the normal user charge will be collected as follows:

- a. \$0.1747 per pound of BOD in excess of 300 mg/l;
 - b. \$0.1041 per pound of SS in excess of 300 mg/l.
- (4) The user charge portion of the surcharge is as follows:
- a. \$0.0715 per pound of BOD in excess of 300 mg/l;
 - b. \$0.0554 per pound of SS in excess of 300 mg/l.

(d) *Toxic pollutants.* Any user which discharges any toxic pollutants which cause an increase in the cost of managing the effluent or the sludge from the city's treatment works, or any user which discharges any substance which singly or by interaction with other substances causes identifiable increases in the cost of operation, maintenance, or replacement of the treatment works, shall pay for such increased costs. The strength of effluent shall be determined by the responsible plant operating personnel and users shall be charged the additional surcharge rates as provided by this section.

(e) *Applicability.* The user charge rates established in this section apply to all users, regardless of their location, of the city's treatment works. (Code 1962, § 8-5A-4; Ord. No. 1995-19, § 1, 7-18-95)

Sec. 25-115. Review and modification.

(a) The city will review the user charge system at least every two (2) years and revise user charge rates as necessary to ensure that the system generates adequate revenues to pay the costs of operation and maintenance including the replacement and to ensure that the system continues to provide for the proportional distribution of operation and maintenance including replacement costs among users and user classes.

(b) The city will notify each user at least annually, in conjunction with a regular bill, of the rate being charged for operation and maintenance, including replacement of the treatment works. (Code 1962, § 8-5A-5)

Sec. 25-116. Delinquent charges; collection by county.

Pursuant to the authority of C.R.S., section 31-20-105, the city council does hereby elect to certify to the county treasurer for collection of any and all delinquent sewer service charges due and payable to the city, to be collected by the county treasurer and paid over to the city in the same manner as ad valorem real property taxes are authorized to be collected pursuant to C.R.S. title 31.

(Code 1962, § 8-5A-6)

Secs. 25-117—25-130. Reserved.**ARTICLE IV. UTILITY REFUND PROGRAM*****Sec. 25-131. Eligibility.**

All users of the city water utility and sewer utility shall be entitled to refunds against charges made for water, sewer and sanitation services if such individuals are eligible and qualify pursuant to the provisions of this article.

(Code 1962, § 12-4-5)

Sec. 25-132. Purpose.

The utility refund program is enacted for the purpose of making refunds to certain qualifying low income residential homeowners for purposes of making more equitable the burden placed upon them by the city's charges for water, sewer and sanitation services (hereinafter referred to as utility charges). Such refunds will be expended from the general fund.

(Code 1962, § 8-8-1)

Sec. 25-133. Definitions.

The following words, terms and phrases, when used in this article, shall have the meanings ascribed to them in this section, except where the context clearly indicates a different meaning:

Income means all money received by the residential homeowner and members of his immediate family residing in the residential dwelling

*Cross reference—Finance, § 2-126.

during the year which is available for use to provide support for the family or individual. The term encompasses all gross income without offset or deduction for any taxes, expenses or deductions.

Residential means dwellings or structures used for residential purposes and containing no more than two (2) families or groups of individuals living independently of each other.

Residential homeowner means any homeowner who is both the owner of a residential property and a resident of such property located within the city limits.

(Code 1962, § 8-8-2)

Sec. 25-134. Requirements for qualification.

Every residential homeowner desiring to make a claim for a utility refund must submit to the city a written application, on forms to be provided by the city, between January 1 and April 15 of the year following the year for which the refund is being applied for. The qualifications for refund include the following:

- (1) The applicant must own a residential home within the city limits and reside in such residential home on December 31 of the year for which the refund is being claimed;
- (2) The applicant must have occupied and owned property which was subject to city utility charges for at least ten (10) months of the year for which the refund is being claimed;
- (3) The applicant, as an individual, or the family, must satisfy the minimum income requirements as set forth in section 25-135.

(Code 1962, § 8-8-3)

Sec. 25-135. Amount to be refunded.

If the applicant meets the requirements to qualify for a refund as set forth in section 25-134, the city shall refund the amount indicated by the table set forth in this section based upon the applicant's income level and the number of persons within the applicant's family. The refund will be appropriated from the general fund.

Income level (in dollars)	Number of persons in family		
	1	2	3 or greater
Under 8,700	\$ 68.00	\$ 84.00	\$ 104.00
8,701-9,956	.00	84.00	104.00
9,957-11,200	.00	.00	104.00

(Code 1962, § 8-8-4; Ord. No. 1991-7, § 1, 7-16-91)

Sec. 25-136. Duties; authorization of finance director.

The finance director shall administer the utility refund program established by this article. The finance director is authorized and directed to prepare a form application for the refund program established pursuant to this article and to further adopt rules and regulations for implementation of the utility refund program so long as such rules and regulations are not inconsistent with any provisions contained in this article. The finance director shall be responsible for auditing and checking all applications made under the utility refund program. Application forms prepared by the finance director shall require the applicant to verify and sign the application under oath.
(Code 1962, § 8-8-5)

Sec. 25-137. Burden on claimant; audit; right to appeal.

The burden to establish that the applicant is entitled to a refund under the terms of this article shall be upon the applicant. The finance director is authorized to require reasonable support information from all applicants and such support information shall be uniformly required of any and all applicants applying for utility refunds under the terms of this article. Upon audit, the finance director shall be authorized to require all reasonable written and other information necessary to satisfy the validity of the applicant's claim for a utility refund under the terms of this article. Should any claim be denied by the finance director, the reasons therefor shall be set forth in writing and furnished to the claimant, together with an indication that all or a portion of the claim is being denied. The claimant or applicant shall be entitled, if he so desires, to appear along with the finance director before the city manager for an

appeal of the finance director's decision denying the utility refund application, in whole or in part.
(Code 1962, § 8-8-6)

Sec. 25-138. Violation; penalty.

Any person violating the terms of this article through the filing of a false, erroneous or fraudulent application for refund shall be guilty of a violation hereof and upon conviction therefor shall be subject to a fine not to exceed three hundred dollars (\$300.00), imprisonment for a period not in excess of ninety (90) days, or both such fine and imprisonment.
(Code 1962, § 8-8-7)

Secs. 25-139-25-149. Reserved.

ARTICLE V. GAS COMPANY FACILITIES REGULATIONS

Sec. 25-150. Legislative intent.

(a) Certain entities herein referred to as "gas companies" are involved in the transportation, distribution and sale of natural gas within the municipal limits of the city through pipelines, mains and other fixed facilities, using streets, alleys, public property, easements and rights-of-way granted by the city.

(b) The nature of the companies transporting, distributing and selling gas, including, without limitation, their use of public and private easements, streets and rights-of-way, and the potential and actual hazards from the operations of such companies, have a substantial effect upon the health, safety and welfare of the city.

(c) The transportation and distribution of natural gas involves a pervasive and permanent use of city streets, rights-of-way and public places; and such use is necessary in order for these gas companies to conduct their business.

(d) The city operates storm drainage, water and sewer utilities using city streets, rights-of-way and public places, including those which are or may be used by gas companies to conduct their business. In addition, such streets, rights-of-way and

public places are utilized by the provider of electrical service to the citizens of the city.

(e) For purposes of protecting the public health, safety and welfare and in order to serve the convenience of the citizens of the city, it is necessary to coordinate activities relating to the use of the city streets, rights-of-way and public places, including but not limited to, the placement of and relocation of facilities, excavations, construction and maintenance by gas companies.

(f) The regulations imposed herein are a matter of local concern relating to the use of public property by gas companies and are imposed upon all gas companies doing business within the city.

(g) In order to provide for public health, safety, welfare and convenience, the city enacts this article, which governs the location and relocation of gas company facilities as well as any excavation, opening or other use of public streets, rights-of-way and public places for the purposes of gas transportation, distribution and sale.
(Ord. No. 1991-18, § 1, 12-17-91)

Sec. 25-151. Definitions.

The following words, terms and phrases, when used in this article, shall have the meanings ascribed to them:

Facilities shall mean all physical components and all facilities reasonably necessary to provide or which are used in the provision of natural gas directly or indirectly into, within and through the city for transportation, distribution and sale and includes, but is not limited to, plants, works, systems, distribution structures, lines, equipment, pipes, mains, underground links, gas compressors and meters.

Gas or natural gas shall mean such gaseous fuels as natural, artificial, synthetic, liquified natural, liquified petroleum, manufactured or any mixture thereof.

Gas companies shall mean any entity that sells, provides, delivers or distributes gas within the corporate limits of the city through pipelines, mains and other related facilities and appurte-

nances located in whole or in part on easements and rights-of-way granted by the city.
(Ord. No. 1991-18, § 1, 12-17-91)

Sec. 25-152. Permit procedure.

(a) When a gas company seeks to make, causes or permits to be made any excavation or opening in or under the surface or pavement of any street, alley, sidewalk, right-of-way or public property, it must apply for and receive a permit from the city.

(b) Applications for a permit for excavation shall be filed pursuant to section 21-66 of this Code. All applicants shall comply with the terms and provisions of Article V of Chapter 21 of the Code as well as the provisions of this article.

(c) Except as described in section 25-158, prior to any construction or excavation in streets, alleys or public ways, the gas company or its contractor shall submit a traffic control plan consistent with policies of the city. Adequate traffic control measures shall be provided for all excavations in the public right-of-way.
(Ord. No. 1991-18, § 1, 12-17-91)

Sec. 25-153. Review of construction and design.

(a) Except in emergency circumstances, prior to construction of any significant gas facilities above or below ground within or affecting public rights-of-way, easements or other public property or the construction of any building or similar structure within the city, each gas company shall furnish to the city the plans for such facilities and a report of the impact of its proposed construction upon public property.

(b) The plans and report required by this section shall be submitted in completed form to the director of public works or his designee at the time application is made for a building permit or an excavation permit.

(c) The plans and reports required by this section may be reviewed by the city to assure:

- (1) That all applicable laws including building and zoning codes and air and water pollution regulations are complied with;

- (2) That city standards pertaining to landscaping are complied with;
- (3) That aesthetic and good planning principles are duly incorporated; and
- (4) That adverse impacts on public property have been minimized.

(d) In the construction of any facilities or any plant, building or similar structure within the city, gas companies shall comply with all regulatory requirements of the city and shall incorporate all other reasonable changes required by the city consistent with prudent engineering practice. Such regulations shall include, but not be limited to, the following matters:

- (1) Location of facilities in streets, alleys and dedicated easements and driveways;
 - (2) Interference with the city's water mains, sewer mains and storm drainage facilities or any other municipal use of the city's streets and rights-of-way;
 - (3) The minimization of interference with trees and other natural features and vegetation; and
 - (4) Interference with traffic and other transportation within the city.
- (Ord. No. 1991-18, § 1, 12-17-91)

Sec. 25-154. Excavation and construction.

(a) All construction, excavation, maintenance and repair work done by any gas company in or affecting public streets, alleys, rights-of-ways and public places shall be done in a timely and expeditious manner which minimizes the inconvenience to the public and individuals. Gas companies shall be liable for any damage to the city caused by their failure to act in a timely manner.

(b) All public and private property in dedicated easements disturbed by gas company construction or excavation activities shall be restored by the gas company at its expense to a condition at least equal to its former condition subject to inspection by the director of public works or his designee. All gas companies operating within the city shall comply with reasonable remedial action required by said official pursuant to inspection.

(c) Each gas company shall comply with the city's requirements for reasonable and prompt action to remedy all damage to private property adjacent to streets or dedicated easements where the gas company is performing or has performed excavation or construction work.
(Ord. No. 1991-18, § 1, 12-17-91)

Sec. 25-154.1. Installation and maintenance of company facilities.

(a) The installation, maintenance, renovation and replacement of any facilities by the company shall be subject to permits (and fees related thereto), and inspection and approval of location by the director of public works or his designee.

(b) All company facilities shall be installed in dedicated easements and/or rights-of-way so as to cause a minimal amount of interference with such property.

(c) Each gas company shall erect and maintain its facilities in such a way as to minimize interference with trees and other natural features and vegetation.

(d) Each gas company shall keep in good working order all facilities constructed, erected or used within the city.

(e) Each gas company and all subcontractors shall comply with all local regulations and ordinances.

(f) Each gas company will comply with all city requirements regarding curb and pavement cuts, excavation, digging and related construction activities as well as any reasonable direction provided by the city regarding replacement of lines and other similar facilities within the city.
(Ord. No. 1991-18, § 1, 12-17-91)

Sec. 25-155. Obligations regarding company facilities.

Each gas company shall install, repair, renovate and replace facilities with due diligence in a good and workmanlike manner, and all such facilities shall be of sufficient quality and durability to protect the health, safety and welfare of the public and shall be kept and maintained by gas companies in a safe and suitable condition,

and in good order and repair. In the event that the city incurs any out-of-pocket expenses paid to third parties who are not employees of the city to obtain compliance with the gas company's use of any public way or public place, the gas company shall reimburse the city for such expenses reasonably incurred.

(Ord. No. 1991-18, § 1, 12-17-91)

Sec. 25-156. Noninterference with public works.

Gas company facilities shall not interfere in any way with the city's water mains and facilities, sewers mains and facilities, storm drainage systems and facilities, or other municipal use of streets and rights-of-way.

(Ord. No. 1991-18, § 1, 12-17-91)

Sec. 25-157. Relocation of facilities.

(a) Upon receipt of reasonable advance notice, not to be less than five (5) business days, a gas company shall, at its own expense, protect, temporarily disconnect, temporarily relocate in the public way or temporarily remove from the public way, any property of the gas company when lawfully required by the city by reason of traffic conditions, public safety, street construction, change or establishment of street grade, installation of sewers, drains or water pipes, or any other type of public structures or improvements by the city; provided, however, the gas company shall in all cases have the right of abandonment of its property.

(b) If at any time the city requests the gas company to permanently relocate any facilities installed or maintained in public ways in order to permit the city to make any use of public ways to construct any public improvement or to build any public project, such relocation shall be made by the gas company at its expense and shall be completed within a reasonable time not to exceed one hundred eighty (180) days from the date upon which the city requests that such relocation work commence; provided, however, that such time period may be enlarged with approval of the city, which approval shall not be unreasonable withheld.

(c) The gas company may be granted an extension of time for completion equivalent to any delay

caused by conditions not under its control, provided that such gas company proceeds with due diligence at all times.

(d) Following temporary or permanent relocation of gas company facilities, all property shall be restored to a condition at least equal to its former condition at the expense of the gas company.

(e) Nothing herein contained shall be construed to impose any obligation upon the city to make any payment for relocation of facilities.

(Ord. No. 1991-18, § 1, 12-17-91)

Sec. 25-158. Emergencies.

Any provision of this article to the contrary notwithstanding, a gas company may take such immediate unilateral actions as in its determination are necessary to protect the public health, safety, property and welfare in the event of an emergency. "Emergency" shall mean a leak, line break, explosion or fire. Such gas company shall within twenty-four (24) hours of the commencement of such emergency action notify the city of the emergency and of the general nature of the action taken and shall, within forty-eight (48) hours of the commencement of such emergency action, apply for any necessary permits as required pursuant to section 25-152 of this article and shall thereafter comply with all other provisions of this article. It shall be duty of such gas company to fully repair and restore any and all public rights-of-way, easements or other public property to a condition at least equal to its former condition in accordance with section 25-153 of this article promptly upon resolution of such emergency. It shall also be the duty of such gas company to otherwise restore the city to its former position by promptly reimbursing the city for any other loss suffered by the city as the result of such emergency, whether such loss be direct, indirect, consequential or incidental.

(Ord. No. 1991-18, § 1, 12-17-91)

Sec. 25-159. Indemnification.

Each gas company shall indemnify and hold harmless the city from and against all lawsuits, liability, damage, claims, demands, judgment and losses whatsoever in nature, and reimburse the city for all its reasonable expenses arising out of

the operations of the gas company within the city, including any third-party claims, administrative hearings, and litigation. None of the city's expenses reimbursed pursuant to this section shall be surcharged. Nothing herein contained shall obligate any gas company to hold the city harmless or indemnify the city to the extent any lawsuits, liability, damage, claims, demands, judgments or losses shall have been found to have arisen out of or in connection with any negligent act, failure to act or intentional wrongdoing of the city or of its officers, agents or employees by final decision of the court or administrative agency of competent jurisdiction in an action where the city is a party. (Ord. No. 1991-18, § 1, 12-17-91)

Sec. 25-160. Savings clause.

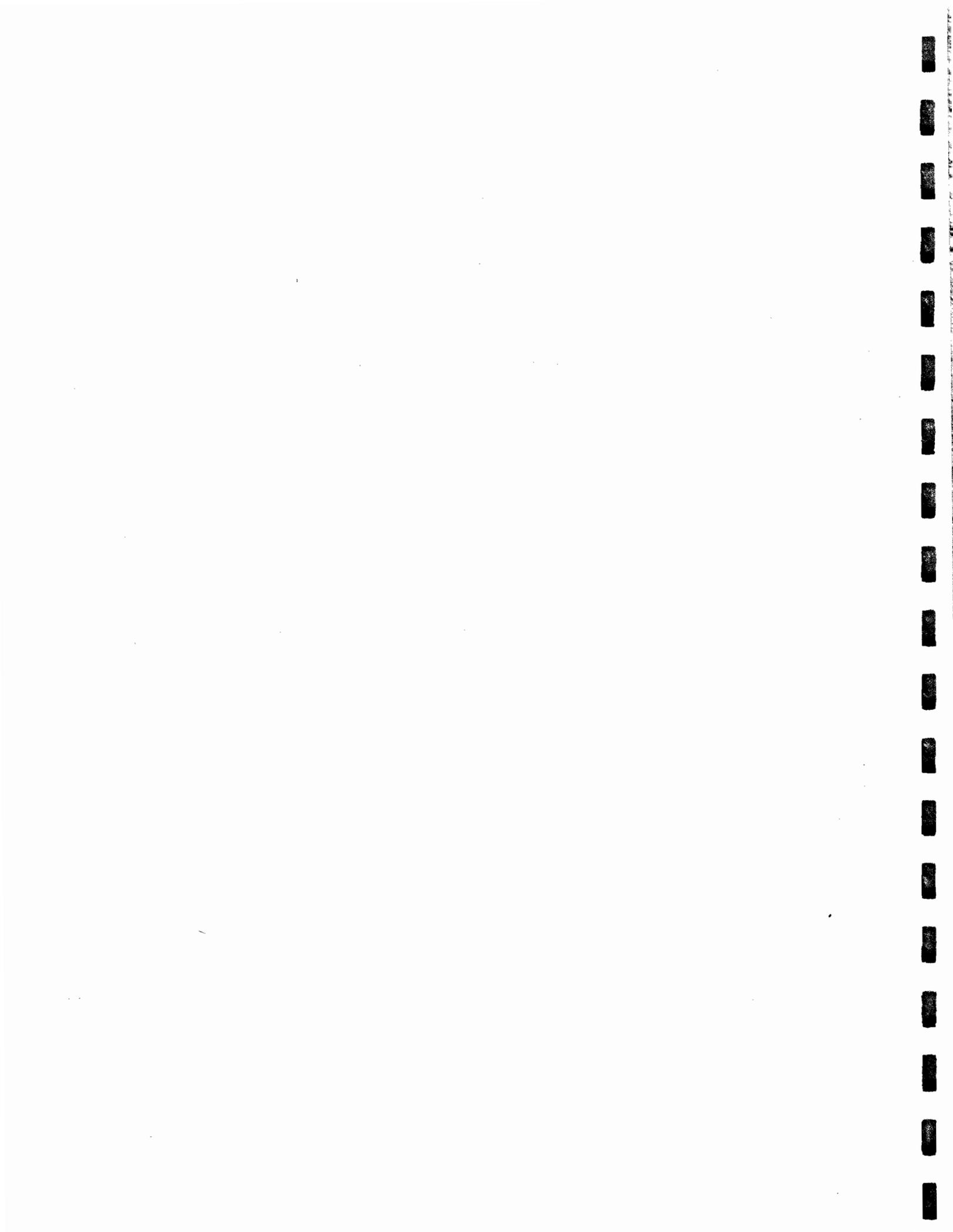
If any portion of this article is held unconstitutional or otherwise unlawful, the remaining sections of this article shall remain effective and are, for that purpose, hereby declared to be severable. (Ord. No. 1991-18, § 1, 12-17-91)

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CITY OF DURANGO

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SECTION 100

STANDARD SPECIFICATIONS FOR CONSTRUCTION

WATER LINES, SANITARY SEWERS, AND STORM DRAINAGE FACILITIES

100.0 GENERAL

100.1 DESCRIPTION: These specifications include material specifications and construction requirements for underground water, sewer and drainage systems installed in the City right-of-way and in other areas under City jurisdiction or ownership.

100.2 SPECIFICATION MODIFICATIONS: Portions of these specifications may be modified or deleted by appropriate items in the Special Conditions or notes on the contract drawings. All modifications and deletions shall be approved by the City Engineer.

100.3 REVISIONS OF STANDARDS: When reference is made to a Standard Specification (ASTM, AWWA, AASHTO, etc.), the specifications referred to shall be understood to mean the latest revision of said specification as amended at the time of the Notice to Bidders.

100.4 PUBLIC SAFETY AND TRAFFIC ACCESS: The Contractor's operations shall cause no unnecessary inconvenience. The safety and access rights of the public shall be considered at all times.

Vehicular access to residential driveways shall be maintained to the property line except when necessary construction precludes such access for reasonable periods of time. If backfill has been completed to such an extent that safe access may be provided, and the street opened to local traffic, the Contractor shall immediately clear the street and driveways and provide and maintain access.

The Contractor shall cooperate with the various parties involved in the delivery of mail and the collection and removal of trash and garbage to maintain existing schedules for these services.

100.5 BARRICADES AND WARNING SIGNS: All signs, barricades, flagmen, lights and other devices necessary for the protection of work and safety of the public shall be the Contractor's responsibility. A traffic control plan shall be submitted and approved by the Traffic Engineer prior to beginning construction where any construction activity will involve the use of public right-of-way.

100.6 LOCATION AND PROTECTION OF UTILITIES: The locations of existing utilities shown on the construction drawings are approximate only. The Contractor shall be responsible for the exact locations and protection of all utilities encountered.

In the event of a break in an existing water main, gas main, sewer or underground cable, the Contractor shall immediately notify the responsible official of the organization operating the utility interrupted and shall lend all possible assistance in restoring services.

- 100.7 INTERRUPTION OF WATER SERVICE: The Contractor shall not discontinue water service to any residence, business or other occupied dwelling without notifying the organization operating the water line at least 24 hours in advance. The residents of all dwellings to which water service is temporarily discontinued shall be notified by the Contractor not less than thirty (30) minutes before the water is shut off. Water service shall not be discontinued for more than two (2) consecutive hours without special written permission from the Engineer.
- 100.8 REMOVAL OF PLANTINGS: Where trees, hedges, shrubs or other ornamental planting within the construction limits are not designated to be protected or saved, the Contractor shall notify the owner of the property fronting the plantings in question not less than ten (10) days prior to removing the plantings. This notification shall include allowing the property owner the option to transplant the plantings fronting his property onto his property instead of having the Contractor remove them.
- 100.9 MUD AND EARTH TRACKING ON PUBLIC STREETS: The Contractor shall conduct his operations so as not to have the equipment tracking mud and earth onto the adjacent public streets. Upon notification by the City Engineer or his representative, the Contractor may be required to clean from the public streets mud and/or earth tracked by his equipment or that of material suppliers to the project.
- 101.0 MATERIALS:
- 101.1 GENERAL: This section covers pipe and other materials to be used in the construction of the various types of underground utilities.
- All materials used shall be new and in conformance with the applicable standards.
- 101.2 CONTRACTOR REQUIREMENTS: All materials to be furnished by the Contractor shall conform to the requirements of these specifications. The type, size and strength class of pipe, fittings and other materials shall be as shown on the plans or otherwise specified in the Contract Documents.
- 101.3 HANDLING: All materials shall be handled with equipment and methods adequate to prevent shock or damage. Under no circumstances shall materials be dropped. Pipe handled on skidways shall not be skidded or rolled against pipe already on the ground. If any part of the coating or lining is damaged, the Contractor shall repair or replace the material at his expense as directed by the Engineer. All pipe and

appurtenances shall be handled in accordance with the appropriate AWWA and ASTM Standards.

- 101.4 STORAGE: The Contractor will be held responsible for the safe storage and protection of all pipe and other materials delivered to the work site. The interiors of all pipe and pipe fittings shall be kept free from dirt and foreign matter at all times. Gaskets for pipe joints shall be stored in a cool location out of direct sunlight.

Any material that has been damaged before actual incorporation in the work shall be repaired or replaced at the Contractor's expense. Any material which does not meet these material specifications shall be removed from the construction site.

- 101.5 PIPE AND FITTINGS FOR SANITARY SEWER CONSTRUCTION: Pipe used in construction of gravity sanitary sewer mains and service lines shall be of vitrified clay, polyvinyl chloride (PVC), or ductile iron or cast iron.

The minimum pipe size for gravity sewers shall be eight (8) inch diameter for mains and laterals, and four (4) inch diameter for service lines. Sanitary sewers under pressure shall be of ductile iron or PVC pipe.

- 101.5a VITRIFIED CLAY PIPE: All vitrified clay pipe and fittings shall conform to ASTM Designation C-700 (extra strength).

Compression joints for clay pipe shall conform to ASTM C-425.

- 101.5b POLYVINYL CHLORIDE PIPE: Polyvinyl Chloride (PVC) sewer pipe and fittings shall conform to ASTM D 3034, Type PSM. The minimum wall thickness for PVC pipe shall conform to Standard Dimension Ratio (SDR) 35.

JOINTS: PVC sewer pipe shall have integral bell and spigot joints. PVC sewer pipe shall be connected with flexible elastomeric seals per ASTM D 3212. Gaskets shall be neoprene or other synthetic rubber material conforming to ASTM D 1689.

FITTINGS: Wyes for 4" or 6" service connections to sewer mains shall be saddle-type fittings made of PVC plastic.

- 101.5c DUCTILE IRON PIPE: Ductile iron pipe for sanitary sewers under pressure shall conform to AWWA C-151. Pipe thickness shall be AWWA Class 52 unless a higher class is required by the City Engineer. Ductile iron pipe shall be cement lined per AWWA C-104.

JOINTS: Unless otherwise specified in the Construction Plans or Special Conditions, ductile iron pipe joints shall be mechanical or push on joints conforming to AWWA C-111. Gaskets shall be neoprene or other synthetic rubber material.

FITTINGS: Fittings for ductile iron pipe shall be in accordance with AWWA C-110 and shall have a pressure rating of not less than that specified for the pipe. Fittings shall be ductile iron or cast iron and shall be cement lined per AWWA C-104.

101.5d PVC PRESSURE PIPE: PVC pipe used for sanitary sewers under pressure shall meet the requirements of AWWA C-900 and shall be Class 150 unless the pressure class is shown on the plans or otherwise specified.

JOINTS: Joints shall be bell and spigot type sealed with an elastomeric gasket conforming to ASTM D-1869 and E-477. The bell section shall be at least as strong as the pipe wall.

FITTINGS: Fittings for PVC pipe shall be of cast iron or ductile iron in accordance with Section 101.5c of these specifications.

101.6 PIPE AND FITTINGS FOR STORM SEWERS, CULVERTS, AND SIPHONS: Pipe shall be galvanized corrugated steel, corrugated aluminum non-reinforced concrete or reinforced concrete.

101.6a CORRUGATED STEEL PIPE: (CSP) Corrugated steel pipe and coupling bands shall conform to the applicable requirements of AASHTO M 36. The pipe shall be made from zinc-coated (galvanized) iron or steel sheets per AASHTO M 218. Unless otherwise specified or approved by the City Engineer, all round C.S.P. shall be fabricated with helical corrugations and a continuous lock or welded seam. If not specified, the wall thickness of C.S.P. shall be per Colorado Division of Highways Standard M-603-MB.

JOINTS: Corrugated steel pipe shall be jointed with gasketed coupling band corrugated to match the ends of the pipe and form a watertight seal. Dimple bands are not permitted. Coupling bands shall be of the same material and have the same coating as the pipe. Gasket material shall be of neoprene or other approved synthetic rubber.

COATING: The inside and outside of all corrugated steel pipe shall be coated with bituminous, polymeric or aluminum material if so specified on the plans.

Bituminous coated CSP shall conform to the requirements of AASHTO M 190, Type A (fully bituminous coated).

Corrugated steel pipe and coupling bands with polymeric coating shall be fabricated from precoated sheets and shall conform to the requirements of AASHTO M 245 and M 246, Type B.

Corrugated steel pipe and coupling band coated with aluminum shall be fabricated from sheet that has been hot-dipped in commercially pure aluminum or approved aluminum alloy. The minimum coating weight on both sides of the sheet shall be 1.0 oz./sq.ft.

101.6b CORRUGATED ALUMINUM PIPE (CAP): Corrugated aluminum pipe and coupling bands shall conform to AASHTO M 196. Unless otherwise specified or approved by the City Engineer, all round corrugated aluminum pipe shall be fabricated with helical corrugations and a continuous lock seam. Unless otherwise specified, the thickness gauge of CAP shall be per Colorado Division of Highways Standard M-603-MB.

JOINTS: Corrugated aluminum pipe shall be joined with gasketed coupling bands of the same alloy as the pipe. Bands shall be corrugated to match the ends of the pipe and form a watertight seal. Dimple bands are not permitted. Gasket material shall be of neoprene or other approved synthetic rubber.

101.6c CONCRETE PIPE: Nonreinforced concrete pipe (NCP) shall conform to the requirements of AASHTO M 86. Reinforced concrete pipe (RCP) shall meet the requirements of AASHTO M 170. The wall thickness and strength class of reinforced and nonreinforced concrete pipe shall be determined in accordance with Colorado Division of Highways Standard M-603 RC unless otherwise specified.

JOINTS: Gasketed bell and spigot joints for watertight concrete pipe shall conform to the requirements of AASHTO M 198.

Concrete pipe with tongue and groove joints may be used for storm drainage only. Tongue and groove joints will not be allowed under paved surfaces.

101.7 PIPE AND FITTINGS FOR WATER MAINS AND SERVICE CONNECTIONS: Pipe for water mains shall be ductile iron. Service pipe shall be of copper or ductile iron.

101.7a DUCTILE IRON PIPE: Ductile iron pipe for water mains shall conform to AWWA C-151, thickness-classes. Pipe thickness shall be AWWA Class 52 unless otherwise specified in the construction plans. Ductile iron pipe shall be cement lined per AWWA C-104.

JOINTS: Unless otherwise specified in the Construction Plans or Special Conditions, ductile iron pipe joints shall be mechanical or push on joints conforming to AWWA C-111. Gaskets shall be of neoprene or other synthetic rubber material.

FITTINGS: Fittings for ductile iron pipe shall be in accordance with AWWA C-110 and shall have a pressure rating of not less than that specified for the pipe. Fittings shall be ductile iron or cast iron and shall be cement lined per AWWA C-104.

101.7b COPPER SERVICE PIPE: Copper tube for water service lines shall be type K, soft temper for underground service conforming to ASTM B-88 and B-251. The pipe shall be marked with the manufacturer's name or trademark and a mark indicating the type of pipe. The outside diameter of the pipe and minimum weight per foot shall not be less than that listed in ASTM B-251, Table 11.

101.7c CURB STOPS, CURB STOP BOXES, CORPORATION STOPS: Curb stops shall be Ford Ball Valves (Ford B-22-333). Curb Stop Boxes shall be Mueller H-10350 or approved equal. Corporation Stops shall be Ford F-600.

101.8 MANHOLES FOR SANITARY AND STORM SEWERS: Manholes shall be constructed in accordance with City Standard Drawing Number S-4.

101.8a CEMENT: All cement used in mortar, concrete bases, and precast manhole riser sections, cones and flat tops, for sanitary sewer manholes, shall be Type V or modified Type II Portland cement having less than five (5) percent tricalcium aluminate. Type II Portland cement may be used in the various concrete elements of storm sewer manholes.

101.8b PRECAST CONCRETE MANHOLE SECTIONS: Manhole risers, cones, flat tops, manhole bases and grade rings shall be precast reinforced concrete sections conforming to ASTM C-478 or AASHTO M 199. Manholes which are 5 feet or less in depth as measured from the invert to the top of rim shall have a flat reinforced concrete top. Manholes greater than 5 feet deep as measured from the invert to the top of rim shall use eccentric conical top section.

Manhole riser and conical sections shall be made with tongue and groove ends for continuous and uniform joints between sections. Such joints shall be sealed with preformed bitumatic material and other approved flexible joint sealant.

101.8c MANHOLE STEPS: Manhole steps shall be of plastic coated steel or other approved materials. The rungs shall be 10 inches wide with non-slip surface free from splinters, burrs or sharp edges which may be a hazard. The legs shall be long enough to provide a 3-1/2 inch minimum embedment length and 6 inch projection from the wall.

The steps shall be fabricated with tapered legs which lock into specially formed holes in cured concrete walls or with lugs for embedment in wet concrete.

101.8d RINGS AND COVERS: Manhole rings and covers shall be cast iron. The standard City of Durango manhole shall be Castings Inc., MH-250-24" C.I., Neenah R-1657, Deeter 1258, or approved substitute. The bearing surfaces between the ring and cover shall be machine finished or ground to assure non-rocking fit in any position (See Drawing No. S-4).

101.9 STORM DRAIN INLET BOXES, GRATES AND FRAMES: Storm drain inlets shall be constructed in accordance with the City Standard Drainage Drawing Numbers SS-2 through SS-4.

All inlet grates, frames and curb opening sections shall be of cast iron and all grates shall be bicycle safe.

101.10 MANHOLE ADJUSTING RINGS: To raise grades of manhole rims by 1" to 3", cast iron manhole adjusting rings may be used. The bearing surfaces between the ring and cover shall be machine finished to assure non-

rocking fit. Set screw fasteners shall be included in each adjusting ring. Adjusting rings shall be Neenah R-1979 Series or approved equal. Adjusting rings shall be dimensioned to fit existing rings snugly.

101.11 APPURTENANCES FOR WATER DISTRIBUTION:

101.11a FIRE HYDRANTS: Fire hydrants shall be the dry bowl type and shall conform to the requirements of AWWA C-502. Hydrants shall be Watrous W-B67 or Mueller Centurian A423 (National Standard Thread). No substitutes will be accepted. (See Drawing No. W-1).

The standard hydrant shall have a six-inch inlet construction, a 5 1/4 inch main valve opening, two (2) 2 1/2 inch hose nozzles (National Standard - 7 1/2 threads per inch) and one (1) 5 inch pumper nozzle with 6.055" O.D. male thread (Seagraves Thread). The hydrant barrel shall be marked with a circumferential rib to denote the interceded ground line. The center of the hose nozzles and pumper nozzle shall be at least 14 inches above the ground line mark.

Hydrants shall be of the "traffic" or "breakaway" design, having easily replaceable breaking devices for the gradeline flange and operating stem that prevents damage to the barrel sections upon impact. The hydrant base must be 4'6" below the breakaway base. The breakaway base shall be set at the ground level.

The operating nut and nozzle cap wrench nuts shall be 1 1/2 inches pentagon, measuring from point to opposite flat side at the base and tapering uniformly to 1 7/16 inches at the top. The height of the nut shall not be less than one inch.

The nozzle caps shall be removable and the operating nut opened by turning to the left (counter-clockwise). Nozzle caps shall be securely chained to the upper barrel section.

PAINTING: Fire hydrants shall be painted with Dupont Centari #700-A; White; Alkyd Enamel or an approved substitute.

101.11b GATE VALVES: The minimum requirements for all gate valves shall conform to the standards of AWWA C-500 or AWWA C-509.

All gate valves shall be double disc or resilient wedge, cast or ductile iron body, fully bronze mounted with non-rising stem and parallel seats. The stem and all wearing surfaces shall be bronze or other approved non-corrosive material. Contact surfaces shall be machine finished and all wearing surfaces shall be easily renewable. Nonferrous bushings shall be of substantial thickness tightly fitted and pressed into machined seats. A clockwise turn of the stem shall close the valve. Acceptable brands of double disc gate valves are APS Smith Metropolitan, Mueller, Dresser or Stockham. Acceptable brands of resilient seat gate valves are Watrous, Mueller, and Dresser.

END CONNECTIONS: End connections of gate valves shall consist of mechanical or push-on (rubber gasket) joints conforming to AWWA C-111 or flanged ends in accordance with ANSI B-16.1.

WRENCH NUTS: Wrench nuts shall be made of cast iron and shall be 1 5/16 inches square at the top, 2 inches square at the base, and 1 3/4 inches high.

101.11c **BUTTERFLY VALVES:** Butterfly valves shall conform to AWWA C-504 specifications. Valves shall be manufactured by BIF, Allis Chalmers, or Henry Pratt Co. All valves shall be 200 psi working pressure with direct buried operators. Provision shall be made for locking the disc in the fully open or fully closed position. Counter clockwise turn of the operating nut shall open the valve.

101.11d **VALVE BOXES:** A cast iron valve box and lid shall be provided for each underground valve. Valve boxes shall be 5 1/2-inches diameter, adjustable screw-together type, sized for the type of valve and depth of bury. The lid shall have the word "WATER" permanently cast in the top.

101.11e **AIR AND VACUUM VALVES:** Air and vacuum valves shall be of the type and size specified. They shall be designed for 200 psi working pressure and shall be Crispin Type RN or equal. A separate isolation valve of the same size and pressure rating as the air valve shall be installed between the water main and the air and vacuum valve. The air and vacuum valve shall be housed in a vault made of reinforced concrete pipe or manhole riser section. The vault shall be covered with a precast concrete lid and cast iron manhole ring. The vault shall be insulated in a manner acceptable to the Engineer.

101.11f **BONDING STRAPS:** A bonding strap shall be installed across each joint in the water line to provide metal to metal continuity for tracing purposes. The Contractor shall be responsible for installation. Bonding strap shall be a minimum #9 copper wire properly attached at each end by means of magnesium weld or other approved method.

101.11g **METER VALVES:** Meter valves shall be made of brass and shall be the same size as the service line. The inlet end of the valve shall be threaded in accordance with AWWA C-800 for use with type K flared copper service tubing.

All meter valves shall be provided with an approved locking device and meter coupling attached.

101.11h **FLANGED ADAPTERS:** The flanged adapters shall be Smith-Blair 912 or Baker Series 601 cast flanged coupling adapters with anchor studs or equal approved by the Engineer.

101.11i **FLEXIBLE COUPLERS:** Flexible couplings shall have cast iron or steel sleeves the same as pipe type furnished; ductile iron flanges, bronze bolts and nuts; and wedge-type rubber gaskets. The couplings shall be

designed for a 200 psi working pressure except as noted and each shall be sized to properly fit the ends of the two pieces of pipe being joined. The couplings shall be Smith-Blair Type 433, Baker Series 236 Cast Transition Couplings, or equal approved by the Engineer.

101.11j MISCELLANEOUS APPURTENANCES: Including check valves, service materials, saddles, regulator valves, insulators, pumps, pressure tanks, valve boxes and miscellaneous hardware shall be of a quality acceptable to the Engineer for examination and testing. The acceptance of any appurtenance by the Engineer shall not be a bar to their subsequent rejection if found defective.

101.12 CONCRETE AND MORTAR: All concrete used in construction of manholes, inlet boxes, vaults, concrete encasement, thrust blocks, etc., shall be Colorado Division of Highways "Class B". Unless otherwise specified, all concrete shall be made with Type II Portland Cement.

Cement mortar used in construction of manholes, inlets, vaults, etc., shall be mixed at a ratio of one part Portland Cement to three parts sand. The amount of water used in the mortar shall be the minimum amount required for workability of the mix. Mortar shall be made with Type II Portland Cement unless otherwise specified. Mortar used for the patching of existing manholes shall be non-shrink type approved by the Engineer.

102.0 TRENCH EXCAVATION

102.1 GENERAL: Following are the specifications that shall govern excavations and trenching for pipelines or other underground conduits and appurtenances within the street rights-of-way for the City of Durango.

102.2 RESPONSIBILITY: The Contractor shall notify all utility companies and interested parties prior to commencement of work in order to insure that there will not be interruptions of services during construction. The Contractor shall notify all utility users in advance of any interruption to service. No interruption in service shall exceed 8 hours in duration. The Contractor shall be liable for all damages. An excavation permit must be secured from the City of Durango.

Should any utility be damaged in the construction operations, the Contractor shall immediately notify the owner of such utility and unless authorized by the owner of the utility, the Contractor shall not attempt to make repairs.

In the event that during construction it is determined that any underground utility conduit or any aboveground utility will be encountered, the Contractor shall notify the affected utility company 48 hours in advance so that any anticipated problems can be addressed and utilities located.

- 102.3 SURFACE REMOVALS AND TOPSOIL PRESERVATION: The Contractor shall remove surface materials and obstructions only to the widths necessary for excavation of the trench. All fences, landscaping and structures not designated for removal shall be protected or, if moved, restored to their original condition after construction is complete.

No more than one-half of the width of a street shall have an open trench at any time.

Removal of concrete curbs, gutters, sidewalks and driveways shall be along existing joints or neatly sawed lines.

Where excavation is required under paved areas, the pavement shall be cut in such a manner as to effect a smooth, straight cut edge and as a vertical face six (6) inches minimum beyond the trench wall. Trench width shall be no wider than 12" wider than the conduit to be installed. All vegetation, concrete, asphalt and other refuse removed from the construction limits shall be separated from suitable topsoil and backfill material, and hauled to a disposal site secured by the Contractor.

Where the trench is in an unpaved area, clean topsoil suitable for final grading shall be stripped, stockpiled separately in approved locations, and restored to the surface after the trench is backfilled evenly. Where excavation is in a lawn covered area, the sod shall be cut and removed and replaced after trench filling so as to promote regrowth. Where sod is disturbed, the Contractor shall resod with like grass at his own expense.

- 102.4 STOCKPILING EXCAVATED MATERIAL: Excavated material shall be piled in locations that will not endanger the work, create traffic hazards or obstructed sidewalks and driveways. Fire hydrants, valve boxes, manholes and other utility access points shall be left unobstructed until the work is complete. Gutters and other water courses shall not be obstructed unless other provisions are made for runoff and street drainage.

All surplus material and excavated material unsuitable for backfilling shall be removed from the site and disposed of in areas secured by the Contractor.

- 102.5 TRENCHING WIDTHS: Trenches shall be excavated to the width necessary to permit the pipe to be laid and jointed properly and backfill materials placed and compacted as required. Where conduit is to be installed outside of existing pavement and pipes have an inside diameter of 33 inches or less, the trench shall be excavated at pipe level a minimum of 16 inches wider than the outside diameter of the pipe so that a clear space of not less than 8 inches is provided on each side of the pipe.

For pipes having an inside diameter of 36 inches or greater, the trench shall be excavated at pipe level a minimum of 24 inches wider than the

outside diameter of the pipe so that a clear space of not less than 12 inches is provided on each side of the pipe. Wherever it is necessary to exceed these limits, approval of the Engineer shall be obtained and provision shall be made for the additional load imposed on the pipe. When sheeting is used, the widths indicated above shall be measured to the inside dimension between the sheeting.

102.6 TRENCHES WITH SLOPING SIDES: The banks of trenches shall be kept as nearly vertical as possible, however, where working conditions and easement or right-of-way permit (as determined by the Engineer), trenches may be excavated with sloping sides with the following limitations:

(1) In traveled streets, alleys or narrow easements, only vertical trenches with proper bracing will be allowed.

(2) Where trenches with sloping sides are permitted, the slopes shall not extend below a point 12 inches above the top of pipe. The trench shall be excavated with vertical sides below this point with widths not exceeding those specified on the Standard Detail Sheets (See Drawing No. 0-1).

102.7 TRENCH LENGTH: No more than 200 feet of unbackfilled trench may be left open overnight. During the months of November through April no uncovered trench shall be left overnight. Trenches should be backfilled as soon as possible to eliminate hazards and traffic congestion, but in no case shall the open trench length exceed 400 feet without the consent of the Engineer.

Trenches across existing streets are to be made so that traffic is not closed. Short duration closure may be allowed by the Engineer. In such instances, the Contractor shall notify the City emergency services.

102.8 TUNNELING: No tunneling under sidewalks, curb and gutter or other structures will be permitted, except when line can be pulled or jacked, in which case such line shall be left in place.

102.9 BRACING AND SHEETING OF TRENCHES: All trenches shall be properly braced, sheeted or otherwise supported to provide safe working conditions and protection of the work and adjacent property.

Bracing and sheeting shall conform to the recommendations in the Occupational Safety and Health Standards for Construction (OSHA). A sand box or trench shield may be used in lieu of sheeting and bracing as permitted by OSHA. Unless otherwise approved, all trench support materials shall be removed in a manner that will prevent caving of the sides and movement or other damage to the pipe.

102.10 EXCAVATION BELOW GRADE: Where the excavation is carried beyond or below the lines and grades shown on the plans or staked, the Contractor

shall, at his own expense, refill all such excavated space with suitable granular material.

- 102.10a OVEREXCAVATING FOR ROCK: When bedrock or boulders are encountered in the trench bottom, or loose, stony soil where there is the possibility of pipe being subjected to "point" contacts, the trench shall be overexcavated a minimum of six (6) inches. The overexcavated material shall be replaced with Engineer-approved material and compacted.

If blasting is required for rock excavation, all work with explosives shall conform to Federal and State Laws, and OSHA rules and regulations. Any damage caused by blasting shall be repaired by the Contractor at his expense.

- 102.10b UNSTABLE TRENCH BOTTOM: Where the trench bottom is found to consist of soft, spongy or unstable soil, frozen material, organic matter or any other material that the Engineer determines to be unsuitable for supporting the pipe, an additional depth equal to the outside diameter of the pipe shall be removed and replaced with suitable granular materials, properly compacted to provide adequate support.

- 102.11 REMOVAL OF WATER: Trenches shall be kept free of water during pipe laying operations by draining, pumping or other approved methods. The water level shall be maintained below the trench bottom throughout the placement of bedding, pipe laying, joining and backfilling operations. The dewatering shall be carried out so that it does not destroy or weaken the strength of the soil under or alongside the trench. Water shall be disposed of in a suitable manner without damage to adjacent property or without being a menace to public health and convenience. Under no circumstances shall trench water be discharged into sanitary sewers. The method of disposal of trench water shall be approved by the Engineer.

- 102.12 PREPARING THE TRENCH BOTTOM: If soil conditions are stable, and the trench bottom is of a material that can be cut true and straight, pipe can be installed using the uniform trench bottom for support. The trench bottom must be straight, free of bumps or hollows, and at the correct grade. As the pipe is laid, any irregularities in the trench bottom must be levelled off or filled in with tamped soil. The trench bottom may also be prepared by digging at least 4" deeper than pipe grade and then bringing the trench bottom up to grade with selected refill material tamped to provide the proper cushion for the pipe. A coupling or bell hole shall be dug at each pipe joint so that the pipe is uniformly supported along its length. The hole shall have sufficient length, width and depth to permit assembly of the joint and provide a minimum clearance of two (2) inches between the coupling and the trench bottom (See Drawing No. 0-1).

- 102.13 BEDDING CLASSES: Herein are contained the various classes of Bedding and Cradles (See Drawing No. 0-2).

102.13a Class A Bedding: Class A bedding shall be defined as that method of bedding in which the lower half of the pipe is set in reinforced concrete (2000 psi min.). The minimum thickness of concrete under the lowest part of the conduit shall be 1/4 of the outside pipe diameter but not less than 4 inches.

The trench shall be maintained free of water during placing of the concrete cushion before the concrete has taken its initial set. The concrete shall extend upward around the pipe to the spring line of the pipe barrel. The width of the concrete cradle shall be at least equal to the outside pipe diameter plus 8 inches.

102.13b Class B Bedding: Class B bedding shall be defined as that method of bedding in which the pipe is set on compacted granular material. The trench shall be excavated to a depth below the established grade equal to 1/4 of the outside pipe diameter, but not less than 4 inches. In rock excavation, the minimum depth shall be 6 inches. Compacted granular material shall be placed under the pipe and around the sides of the pipe up to the springline of the pipe barrel. The placing shall be done in a manner which will assure no separation or change in uniform gradation. The granular material shall be consolidated and compacted by hand operated mechanical vibrators to at least 90% of maximum dry density as determined by AASHTO T 180. Granular material shall be placed to one (1) foot above the top of the pipe.

102.13c Class C Bedding (Hand Shaped Bottom): Class C bedding shall be defined as that method of bedding in which the pipe is placed on a native, stable soil foundation shaped to fit and uniformly support the lower quadrant of the pipe barrel for a width of at least 50% of the outside pipe diameter. Bell holes shall be excavated and kept free of foreign material.

The barrel of the pipe shall be bedded throughout its entire length. Native soil shall be hand compacted to springline and then placed to one foot above the top of the pipe and compacted to at least 90% maximum dry density. The remainder of the backfill shall be placed in compliance with the section on trench and excavation backfill.

102.14 GRANULAR, BEDDING AND HAUNCHING MATERIALS.

Granular materials required for bedding of pipe and structures, and haunching around pipe shall meet the following gradation requirements:

<u>Sieve Size</u>	<u>Total Passing by Sizes</u> <u>(% by Weight)</u>
3/4"	100 to 90
1/2"	-----
3/8"	20 to 55
No. 4	0 to 10
No. 8	0 to 5

The aggregate used shall contain not more than a total of 8% by weight of deleterious substances such as clay, shale or organic matter. The plasticity index shall not be over 6.

102.15 STABILIZING MATERIAL: In the event unstable trench conditions are found at pipe line grade, or in the case of over-excavation for rock, (dry) uniformly graded (class 1, 4, or 5) rock shall be used for trench stabilization. Nothing in this bedding material classification is intended to preclude the use of sand bedding provided the sand has a plasticity index of 6 or less, and having no more than 15% passing 100 sieve.

102.16a BACKFILL MATERIAL: In general, backfill shall be that material excavated from pipeline trenches on the site that is free from frozen materials, large amount of organic material, concrete, asphalt, dry clods, muck, debris and rock over three (3) inches in diameter. When, in the opinion of the Engineer, the excavated material is not satisfactory for use as backfill, suitable backfill material shall be furnished by the Contractor and condemned material removed from the site.

Backfill material consisting of earth and rock shall contain a sufficient amount of earth to completely fill all voids between the rocks.

102.16b SPECIAL BACKFILL MATERIAL: Where required on the plans or in the Special Provisions, backfill shall consist of a flowable fill consisting of a plant mixed aggregate cement combination meeting the following specification: 94 pounds portland cement, 200 pounds fly ash, 2,990 pounds fine aggregate, and 49 to 57 gallons of water per cubic yard.

102.17 COMPACTING BACKFILL MATERIAL: Backfill material in trenches shall be compacted to at least ninety (90%) percent of maximum density except for the top three (3) feet of the trench under existing or proposed roads which shall be compacted to at least ninety-five (95%) percent of maximum density. Maximum density shall be defined by AASHTO T 180. All approved backfill material shall be adjusted to within three (3) percent of the optimum moisture content prior to its placement in the trench. When sand is placed as backfill it must have a minimum moisture content of 5%.

102.18 INITIAL BEDDING AND TAMPING: Backfilling should follow pipe assembly as closely as possible. During initial bedding and backfilling, the Contractor shall take all necessary precautions to prevent movement or distortion of the pipe or structure being backfilled. The first step in providing firm, continuous support for the pipeline is to tamp soil solidly under the pipe and couplings. The next step is providing effective support of the pipe in the haunching area. This is accomplished by placing bedding material equally along both sides of the pipe and thoroughly compacting it by hand under the haunches and around the pipe. Tamping should be done in 4" layers. Side support

is accomplished by tamping the soil firmly under the haunches of the pipe to the springline and compacting it out to the undisturbed trench walls.

Backfilling of the trench with bedding material shall continue to a point that is at least one foot above the top of the pipe. The balance of the backfill may be machine placed in lifts not to exceed 24". Compaction between lifts is required by mechanical or other approved means. Trenches outside of proposed roads shall be backfilled to provide for mounding between 6" and 12" over existing natural ground.

102.19 FLOODING OR JETTING OF TRENCHES: Flooding or jetting of trenches shall not be permitted unless approved by the Engineer.

102.20 TESTING: All backfill shall be frequently tested to insure that the required density is being attained. The minimum requirements for compaction testing shall be as follows:

For every 400 lineal feet of trench and each branch or section of trench less than 400 feet in length, at least one compaction test shall be performed at the surface and at mid-trench for excavations greater than 6 feet. Compaction tests shall be taken at random locations along the trench and wherever poor compaction is suspected by the Engineer. If any portion of the backfill placed fails to meet the minimum density specified, the area shall be defined by additional tests if necessary and the material in the designated area shall be removed and replaced to the required density at the Contractor's expense.

All compaction testing shall be performed by an approved materials testing laboratory at the Contractor's expense. It shall be Contractor's responsibility to make necessary excavations in order to accommodate compaction tests at all locations designated.

A summary report of all compaction test results shall be submitted to the office of the City Engineer. These test results are required as a basis of acceptance of facilities by the City.

102.21 RESTORATION OF GROUNDS: The cleanup and restoration of grounds shall be a continuous process from the beginning of construction to final completion of the work. The Contractor shall keep the work site free from the accumulation of debris and waste material caused by his operation.

Immediately after the pipeline is backfilled, the area shall be cleaned and restored to the original grade and condition. See Section 102.3 for grass removal and replacement requirements. All fences shall be replaced to the same elevation and alignment and restored to a condition equal to or better than that at the beginning of construction.

102.22 RESTORATION OF PAVED AND CONCRETE SURFACES: Immediately after any section of a completed pipeline has been tested and accepted by the

Engineer, the Contractor shall replace all paved surfaces removed or damaged by his operation. All asphalt pavement and areas of curb removed shall be replaced with hot mixed bituminous pavement. Paved surfaces shall be restored to their original line and grade and finished to match adjacent undisturbed surfaces. The excavation contractor shall be responsible for the maintenance of the patch for a period of one (1) year or until it is removed and replaced by the City of Durango or their contractor. The equipment used for excavation must be equipped with pads for the stabilizers so as not to damage the street. Also, the front-end loader bucket should have a plank or buffer between the bucket and the street.

103.0 INSTALLATION OF PIPE AND APPURTENANCES: All pipe, valves, hydrants, manholes and other pipeline appurtenances shall be installed and tested in accordance with the construction plans and specifications, applicable AWWA, ASTM or AASHTO Standards and Manufacturer's instructions. When installation instructions or procedures differ, the Engineer will determine which will take precedence over the others.

103.1 INSTALLATION OF SANITARY SEWERS, STORM SEWERS AND CULVERTS: All sanitary sewer facilities shall be in compliance with design criteria of the Colorado State Department of Health. All plastic sewer pipe installed shall be installed in accordance with ASTM-D 2321-89.

103.1a PIPE LAYING: After the trench has been dewatered and the bedding prepared, the pipe shall be laid to the line and grade shown on the plans or staked. Variance from established line and grade shall not be greater than three (3) inches horizontally and one-half (1/2) inch vertically, provided that such variation does not result in a level or reverse sloping invert.

The Contractor shall constantly check line and grade of the pipe with a laser beam or batter boards. Whenever the pipe is found to be outside the specified limits, the misaligned sections shall be removed and relaid to the correct line and grade at the Contractor's expense.

Pipe shall be laid upgrade from the point of connection to the existing sewer or from a designated starting point. Pipe with bell and spigot joints shall be laid with the bell end forward or upgrade.

The inside of the pipe and jointing surfaces shall be kept clean and free from mud, soil, gravel, ground water and other foreign material. When pipe laying is not in progress, the forward end of the pipe shall be kept tightly closed with a temporary plug.

103.1b INSTALLATION OF SEWER SERVICE LINES: Service pipe shall be laid at a minimum grade of one-eighth (1/8) inch per linear foot. The alignment of service lines shall be established by the Engineer.

The maximum deflection permissible at any one fitting or any combination of adjacent fittings shall not exceed 45 degrees, unless otherwise approved.

The service line shall be joined to the sewer main with a wye fitting or approved saddle permanently connected above the spring line of the sewer pipe. The method of tapping the main shall be approved by the Engineer. The service line or wye shall not extend beyond the inside wall of the sewer main.

Where service lines are stubbed out to the right-of-way line and ended for future connection, the end of the pipe shall be plugged and marked with a 2" x 4" x 4' board buried vertically above the end of the pipe and extending to the ground surface or with a 4" wide plastic tape with the words, "WARNING SEWER LINE" marked on the tape extending from the sewer line to the surface (See Drawing No. S-6). The ends of the service lines shall be capped with water-tight plugs braced to withstand test pressures.

103.1c CONSTRUCTION OF MANHOLES: The foundation for each manhole base shall be prepared by replacing unsuitable material with subgrade stabilization material as directed by the Engineer, and placing granular bedding material in accordance with the standard detail sheets.

The manhole base shall be cast-in-place on the line and grade staked or shown on the plans. The invert shall be formed and smoothly finished to match the shape and elevation of all pipes connected to the manhole. The internal diameter of the manhole shall be not less than 48".

Precast manhole bases may be used when laid on a firm unyielding subgrade as determined by the Engineer. Prior to placement of manhole base, the ground surface shall be compacted to a smooth and level supporting surface. Any unevenness or overexcavation shall be brought to final grade using gravel backfill material.

The first pre-cast manhole section shall be placed on the concrete base structure before the base has taken initial set; or the section shall be grouted into a suitable groove formed in the top of the manhole base. The first section shall be adjusted to the proper grade and alignment so that it is uniformly supported by the base concrete and not bearing on any of the pipes.

The remaining pre-cast sections shall be placed and aligned to provide vertical sides and alignment of the ladder rungs. Approved bitumatic sealer shall be placed between pre-cast sections so that the completed manhole is rigid and watertight. Horizontal joints and any holes shall be plastered with non-shrink grout to a smooth finish inside and out.

The manhole ring and cover shall be adjusted to grade with pre-cast grade rings. The total height of grade rings shall not be more than twelve (12) inches. Grade rings shall be grouted together and the cast iron ring set in a bed of mortar at the finished grade elevation.

Where the manhole is in an unpaved street, alley or other area where grade has not been established, 12 inches of grade rings shall be placed between the top of cone and bottom of casting (to allow future adjustment of the ring to grade).

Where the manhole is in a cultivated area, the top of the casting shall be eighteen (18) inches below the existing ground surface.

Where the manhole is in an uncultivated but open area, the top of the casting shall be 6" above the existing ground surface.

All newly constructed manholes shall be cleaned of any accumulation of silt, debris, or foreign matter of any kind, and shall be free from such accumulations at the time of final inspection (See Drawing No. S-4).

103.1d CONSTRUCTION OF STORM INLETS AND VAULTS: Pre-cast or formed concrete boxes for storm inlets and vaults shall be placed on prepared granular bedding, uniformly supported, in correct alignment and at proper grade.

When the box is furnished in more than one section, the sections shall be joined and sealed with an approved bitumatic material so that the completed box is rigid and watertight.

Pipe connections to concrete structures shall be made by approved methods and shall result in a smoothly finished, watertight connection. Pipe ends shall not extend more than one inch beyond the inside face of the structure.

All inlet boxes, vaults and irrigation structures shall be cleaned of any accumulation of silt, debris or other foreign matter and shall be free from such accumulations at the time of final inspection (See Drawing No. SS-2 through SS-6).

103.2 INSTALLATION OF WATER LINES, FORCE MAINS, SIPHONS AND OTHER PRESSURE PIPELINES:

103.2a PIPE LAYING: Pipe shall be laid on the alignment shown on the plans or staked. Unless otherwise specified or approved, all pressure pipelines shall be laid to a minimum depth of forty-eight (48) inches measured from the proposed final ground surface or of the proposed road surface.

The inside of the pipe and jointing surfaces shall be kept clean and free from mud, dirt, gravel, ground water and other foreign material. When pipe laying is not in progress, the open ends of the pipeline shall be kept closed with water-tight plugs. All pipe lengths shall be squarely cut.

Long radius horizontal or vertical curves may be laid with standard pipe by deflections at the joints of rigid pipe. Maximum deflections

at pipe joints shall be per the Manufacturer's recommendations or applicable AWWA Standard.

- 103.2b CONCRETE BLOCKING: Concrete support or thrust blocks shall be poured at all pipe bends, tees, caps, valves, hydrants and other locations shown on the plans. The size and location of blocking shall be as shown on the plans or in accordance with the Standard Drawing No. W-6. Thrust blocks shall be poured on firm, stable foundation material and all bearing surfaces shall be against undisturbed earth.

Concrete for support and thrust blocks shall be made with Type II Portland Cement and shall reach a minimum compressive strength of 3000 psi in 28 days.

Reinforcing steel and bolts used to anchor valves, fittings, etc., to thrust blocks shall meet tensile requirement of ASTM Grade 40. All anchorage steel not embedded in concrete shall be coated with coal tar or other approved coating material.

- 103.2c INSTALLATION OF VALVES AND VALVE BOXES: Each valve shall be installed in a vertical position and anchored to a concrete support block as shown on the Standard Water Line Drawing No. W-6. An adjustable screw type valve box shall be set into position during backfilling operations. The lower section of the valve box shall be cushioned with backfill material so that it does not rest directly upon the body of the valves or upon the water main. The upper section of the unit shall be placed in proper alignment and adjusted so that its top will be at final grade. The completed valve box shall be vertically centered over the valve operating nut and each valve shall be tested for proper access and operation.

- 103.2d INSTALLATION OF FIRE HYDRANTS: Hydrants shall be installed at the locations shown on the plans. They shall be plumb and set so that the bottom of the pumper nozzle is no less than twelve (12) inches above finished grade.

A minimum of 1/4 cubic yard of washed gravel shall be placed around the base of the hydrant to insure proper drainage of the hydrant after use. Blocking of the hydrant shall consist of pouring a solid concrete base of not less than 1/4 cubic yard extending from the hydrant base to the undisturbed soil on the bottom and sides of the trench. Weep holes which drain the hydrant shall not be covered with concrete (See Drawing No. W-1).

- 103.2e INSTALLATION OF WATER SERVICE PIPE: Underground water service pipe shall be laid not less than ten (10) feet horizontally from the building sewer service line. Where this separation is not possible, the water service line shall be at least eighteen (18) inches above the top of the building sewer service line.

Each water service line shall be machine tapped and connected to the water main through a brass corporation stop. The main shall be tapped

at an angle of forty-five degrees (45°) from the vertical, and the stop must be turned so that the T-handle will be on top (See Drawing No. W-7).

103.2f CONNECTION TO EXISTING MAINS: New water main lines shall not be connected to existing mains in service until the new lines have been tested, disinfected at least 25 ppm residual of Cl₂, and accepted by the City, unless an exception is approved by the Engineer.

Where the connection of the new work to old requires interruption of service, the Engineer and the Contractor shall mutually agree upon a date and time for connections which will allow ample time to assemble labor and materials.

104.0 TESTING PIPELINES: All pressure and leakage testing shall be performed by the Contractor under direct control of the Engineer.

104.1 TESTING SANITARY SEWERS: Testing sanitary sewers for acceptability shall include the following tests:

- a. Exfiltration of water or exfiltration of air
 under pressure by Contractor
- b. Deflection of thermoplastic pipe by Engineer
- c. Lamping by Engineer

104.1a EXFILTRATION TESTS: An exfiltration or leakage test shall be performed on all newly constructed sanitary sewer mains. The Contractor will determine whether the test will be made with water or air pressure and shall furnish all labor, tools and equipment necessary to conduct the test.

The exfiltration test will not be considered valid without the presence of the Engineer or his representative throughout the test.

EXFILTRATION OF WATER TEST: The test section shall be sealed off from the remaining pipeline with water-tight plugs inserted in the pipes at the end manholes. The Contractor shall fill the pipe to the test level with potable water at least 24 hours prior to conducting the test. The test level shall be at least eighteen (18) inches above the top of the pipe opening in the upper manhole or eighteen (18) inches above the ground water table, whichever is higher.

Throughout the test period of at least one (1) hour, the water level shall be maintained at the test level and all water added shall be accurately measured. If the exfiltration rate exceeds 0.15 gallon per inch of inside pipe diameter per hour per 100 feet of pipe length, the leaks shall be located and repaired at the Contractor's expense, and the pipeline retested until the leakage is within the allowable limits.

AIR LEAKAGE TEST: If the Contractor chooses to test for exfiltration with air pressure, the testing shall be in accordance with ASTM Standard C-828. The ends of the test section shall be sealed at the

manholes with pneumatic plugs. One of the plugs provided shall have two taps. One tap will be used for introducing air into the pipeline through suitable valves and fittings so that the input air may be regulated. The second tap shall be fitted with valves and fittings to accept a pressure gauge to monitor the internal pressure of the sewer pipe.

The pressure gauge shall meet the following minimum specifications:

- Size4 1/2 inches diameter
- Pressure range0-15 psi
- Figure intervals1 psi increments
- Minor Subdivisions0.05 psi
- Pressure tubeBourdon tube or diaphragm

PROCEDURE: Connect the pressure gauge and air control equipment to the proper fittings and slowly apply air pressure. Pressurize the pipe line to 4.0 psig and throttle the air supply to maintain between 4.0 and 3.5 psig for at least two (2) minutes in order to allow equilibrium between air temperature and pipe walls. During this time check all plugs for leakage. If plugs are found to leak, bleed off air, tighten plugs and repressurize the pipeline. After the temperature has stabilized, allow the pressure to decrease to 3.5 psig. At 3.5 psig begin timing to determine the time required for pressure to drop to 2.5 psig. The time, in seconds, for the air pressure to decrease from 3.5 psig to 2.5 psig should be greater than the minimum test time shown in the following table:

MINIMUM TEST TIME FOR VARIOUS PIPE SIZES

Nominal Pipe Size, in.	T(time) min/100 ft.	Nominal Pipe Size, in.	T(time) min/100 ft.
		21	3.0
4	0.3	24	3.6
6	0.7	27	4.2
8	1.2	30	4.8
10	1.5	33	5.4
12	1.8	36	6.0
15	2.1	39	6.6
18	2.4	42	7.3

If the air test fails to meet the above requirements, the leaks shall be located and repaired at the Contractor's expense, and the pipeline retested until the leakage is within the allowable limits.

In areas where the ground water level is above the pipe, the hydrostatic pressure of the ground water above bottom of the pipeline shall be determined and added to all test pressures.

104.1b

DEFLECTING TESTING FOR PLASTIC PIPE: All PVC and ABS composite sewer lines will be tested for excess deflection by the Engineer. The maximum allowable deflection of flexible pipe shall not exceed seven

and one-half percent (7 1/2%) of the Base Inside Diameter as established in ASTM D3034-81. The following values from ASTM D3034-81 shall apply:

<u>Nominal Pipe Size, in.</u>	<u>Base Inside Diam., in.</u>	<u>7 1/2% Deflection Mandrell Diam. in.</u>
6	5.742	5.31
8	7.665	7.09
10	9.563	8.84
12	11.361	10.51
15	13.898	12.86

The deflection test will be performed by pulling a "go-no-go" mandrel up-grade through the pipe from manhole to manhole. Where deflection is found to be in excess of allowable testing limits, the Contractor shall excavate to the point of excess deflection and remove the deflection by recompacting around the pipe or other approved method. After backfilling, the line shall then be retested for deflection. If the line has failed to return to its original size (inside diameter) the deflected pipe shall be replaced by the Contractor at his expense.

104.1c LAMPING TEST: Lamping will be performed on all sanitary sewer pipe by the Engineer. In order to pass the lamping test, three-fourths (3/4) of the pipe circle shall be observed both vertically and horizontally between manholes.

104.2 TESTING STORM SEWERS AND CULVERTS: Testing of all gravity flow pipeline, other than sanitary sewers, shall consist of a physical inspection by the Engineer. All pipelines and sewer lines will be lamped to check for proper alignment and uniformity of grade.

All plastic pipe will be subject to deflection testing by the Engineer. The maximum allowable deflection of any flexible pipe shall be seven and one-half percent (7 1/2%) of the base inside diameter of the pipe as defined above.

104.3 TESTING PRESSURE PIPELINES: Water main, force mains, siphons, and all other pipelines that will operate under pressure shall be tested for pressure and leakage in accordance with these specifications and AWWA Standard C-603, Section 4.

The Contractor shall furnish all labor, equipment, tools, water and other incidental items required to conduct the tests. Test results will not be considered valid without the presence of the Engineer or his representative throughout the test.

No pressure testing shall be performed until all thrust blocks have been placed and cured for at least two (2) days, and the pipeline backfilled adequately to prevent any movement or lifting of the pipe. Pavement or other permanent surfaces shall not be placed until all pressure and leakage tests are satisfactorily completed.

- 104.3a TEST PRESSURE: Unless otherwise specified, the test pressure for all pipes shall be double the operating pressure at the lowest elevation of the test section or the class designation of the pipe plus fifty (50) psi, whichever is less, except that the minimum test pressure for water distribution lines shall be one hundred fifty (150) psi.
- 104.3b FILLING: The pipeline shall be filled with potable water at least twenty-four (24) hours before being subjected to the hydrostatic pressure test. Each section of pipeline shall be filled slowly and all air expelled by means of taps at points of highest elevation. Tapping to remove air shall be the responsibility of the Contractor and location of taps shall be approved by the Engineer.
- 104.3c PROCEDURE: The pressure and leakage tests may be performed simultaneously or separately. The total time for the combined pressure and leakage tests shall be a minimum of two (2) hours for each section of pipeline. If separate tests are made, the pressure test shall be made first. The duration of the pressure test shall be a minimum of one (1) hour and the duration of the leakage test shall be a minimum of four (4) hours. The pressure of the leakage test may be reduced to one hundred and fifty percent (150%) of the maximum working pressure that will occur on that portion of the line.

The specified test pressure shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Engineer. No pipe installation will be accepted if the leakage for the section of line being tested is more than the rate calculated using the following formula, except that leakage for Asbestos-Cement pipe shall conform to provisions of AWWA C-603.

$$L = \frac{ND\sqrt{P}}{7,400}$$

where L = allowable leakage in gallons per hour
 N = number of joints in length of pipeline tested
 D = nominal diameter of pipe in inches
 P = average test pressure in psi gauge

Leakage is defined as the quantity of water to be supplied to the section of pipeline being tested, which is necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled.

- 105.0 DISINFECTION OF WATER LINES: After completion of pressure and leakage testing and prior to being placed into service, all new water mains and repaired portions of or extensions of existing mains shall be chlorinated by the Contractor in accordance with AWWA Standard C-601.
- 105.1 PREVENTING REVERSE FLOW: Valves shall be manipulated so that the strong chlorine solution in the line being treated will not flow back into the line supplying the water.
- 105.2 CHLORINATING VALVES AND HYDRANTS: In the process of chlorinating newly laid pipe, all valves or other appurtenances shall be operated while

the pipeline is filled with the chlorinating agent and under normal operating pressure.

105.3 FINAL FLUSHING AND TESTING: Following chlorination, all treated water shall be thoroughly flushed from the newly laid pipe at its extremity until the replacement water throughout its length shows upon test a chlorine residual of less than 2 mg/l.

105.4 BACTERIOLOGICAL TESTING: Following flushing samples shall be collected by the Contractor for testing for bacteriological quality. Each 1,000 feet of water main shall be sampled and tested and results of the test supplied to the City before acceptance of any portions of the line.

106.0 FINAL INSPECTION AND ACCEPTANCE: The acceptance of all pipelines by the City will be based on the following:

1. Submittal of satisfactory results of required tests (such as pressure test, leakage tests, compaction, bacteriological tests, etc.) certified by the Engineer or an approved independent laboratory.
2. Passing a final inspection of the work by the City Engineer or his representative.
3. Submittal of "As-Built" construction drawing on 24" x 36" reproducible mylar or other suitable material.

107.0 MEASUREMENT AND PAYMENT: The complete and accepted pipeline will be paid for in accordance with the contract bid items listed in the bid schedule, approved change order, and with these specifications.

The unit prices bid for the various contract pay items shall be full compensation for furnishing all materials, labor, equipment, tools and other incidental items required for completion of the work in accordance with the construction plans and specifications.

The quantities shown on the bid schedule are approximate only. Payment will be based on measurement of actual quantities installed and approved.

107.1 CONDUIT: Unless otherwise specified, conduit of the various sizes, types and classes shown on the bid schedule will be paid for at the contract unit price per linear foot of pipe installed and approved. Measurement will be made along the centerline of the conduit from end to end. The footage of conduit to be paid for will include the lengths of fittings, valves and valve vaults in line with the pipe but will not include the lengths of manholes, drain inlet boxes, culvert end sections, or other structures in line with the pipe.

107.2 VALVES AND HYDRANTS: Valves and fire hydrants will be paid for at the contract unit price "each" for the different sizes, types and classes

listed in the bid schedule. The number of valves and hydrants to be paid for will be the number of units furnished, installed and approved.

- 107.3 WATER SERVICE LINES: Water service lines will be paid for at the contract unit price per linear foot for each size of line installed and approved. This price shall include the cost of furnishing and installing a corporation stop and curb stop and curb stop box on each service line.
- 107.4 MANHOLES AND INLETS: Manholes and storm drain inlets will be paid for at the contract unit price "each" for the various sizes, types and depths listed in the bid schedule. The number of manholes and inlets to be paid for will be the number of complete units (including ring and cover or grate and frame) constructed and approved.
- 107.5 GRANULAR STABILIZATION MATERIAL: When the use of the granular stabilization material is ordered or authorized by the Engineer, it will be paid for at the contract unit price per ton of material placed and approved. The tonnage of material to be paid for will be determined from weight tickets collected by the Engineer at the time of delivery on the job site or delivered daily to the Engineer by the Contractor. Weight tickets not delivered daily will not be used in calculating payment.

For each load of granular stabilization material delivered, a weight ticket shall be given to the Engineer's field representative by the driver of the truck or, in the absence of an Engineer's representative, to the Contractor's foreman. Each ticket shall have the following information recorded on it:

Date _____
Truck No. _____
Total Weight _____
Tare Weight _____
Weight of material delivered _____
Truck driver's signature _____

- 107.6 ROCK EXCAVATION: No payment will be made for "rock excavation" unless the method and costs of such work are established and approved by the Engineer in writing before any rock excavation is done.
- 107.7 PAVEMENT REPLACEMENT: The area of pavement replacement to be paid for will be the same area designated for removal. Where pavement is removed beyond the limits designated on the plans or otherwise approved, the Contractor shall replace the pavement at his own expense. The contract unit price per square yard for "Pavement Replacement" shall be full compensation for replacement of the pavement structure, including all hot bituminous pavement and aggregate base course required to restore the paved surface to its original condition.
- 107.8 INCIDENTAL CONSTRUCTION: Unless otherwise specified or provided for, the following list of materials and items of work will not be paid for

separately but will be considered incidental to the contract pay items and all costs of these incidental items shall be included in the contract prices for the various pay items.

1. The furnishing and maintenance of barricades, warning signs and other traffic control devices.
2. All surface removals including removal of asphalt pavement, concrete, fences, plantings and structures.
3. The location and protection of existing utilities.
4. All excavation (for trenches, compaction tests, etc.) except rock excavation. (See section 107.6 for payment for rock excavation.)
5. The support bracing and sheeting of trenches.
6. The dewatering of trenches.
7. The furnishing and placement of all granular bedding and haunching material, and all backfill material with moisture and density control.
8. The clean-up and restoration of grounds.
9. The removal and disposal of all waste materials including excess excavated material, trash and debris resulting from the work.
10. The furnishing and installation of tracing wire.
11. The furnishing and installation of concrete support and thrust blocking required on pressure pipelines.
12. All pressure and leakage testing.
13. The flushing and disinfection of waterlines. Water from City mains for the required flushing and disinfection shall not be charged to the Contractor. Water for compaction, cleanup, and non-required flushing shall be a Contractor expense, and, if City water is used, shall be paid for at the rate of \$0.84/1000 gallons.
14. The connection of new pipeline to existing facilities.
15. The separation, removal and disposal of muck, large rock, organic matter or other materials from project excavations which in the opinion of the Engineer are unsuitable for use in the backfill. No separate or additional payment will be made for hauling unsuitable materials to the Contractor's disposal site.

SECTION 200

STANDARD SPECIFICATIONS FOR CONSTRUCTION

STREETS AND ROADS

200.0 GENERAL: The intent of this section is to specify materials and methods to be used for the construction or overlaying of streets, roads, parking lots, walks, drainways and other miscellaneous work requiring the use of asphalts and aggregates. The work covered shall include general requirements that are applicable to embankment and subgrade preparation, roadway excavation and grading, aggregate base course, bituminous tack coat and asphalt concrete overlay. All workmanship and materials shall be in accordance with the requirements of these specifications, and in conformity with the lines, grades, depths, quantity requirements and the typical cross section shown on the plans or as directed by the Engineer.

201.0 PERMITS AND INSPECTION: Permits shall be obtained before work begins (see General Conditions). The Contractor shall call for inspection from the City of Durango, giving 24 hours minimum notice, before the placement of any material. In the event that any of the work or material fails to meet any of the requirements of the specifications, written notice of rejection shall be given to the Contractor and work shall be halted until such time as corrective action is taken.

A complete set of the approved drawings and a valid permit shall be on the job site and available to the Engineer at all times.

The Contractor shall be licensed and bonded for work in the City of Durango.

Inspection is only an aid to the Contractor and in no way reflects a responsibility on the part of the City for quality or quantity control, and in no way implies acceptance of the work or any part thereof by the City of Durango.

202.0 TESTING: A number of quality control tests shall be performed by an approved Material Testing Laboratory to determine compliance with the requirements of this section. An approved laboratory shall be construed to mean any institution or firm properly equipped to perform such tests and who has in their employment a registered professional engineer experienced in testing. The tests will be performed at the Contractor's expense and all test results shall be submitted to the Engineer for approval prior to the placement of any material or, in the case of in-place testing, prior to acceptance of any work by the City. All materials, whether or not in place, failing to meet the requirements herein set forth, after testing, shall be removed, replaced (if necessary) and retested at the Contractor's expense.

Several basic tests and their minimum frequencies are listed below; these and any additional tests are more fully described in the text for each specification.

REQUIRED QUALITY CONTROL TESTS:

<u>Item</u>	<u>Type of Test</u>	<u>Minimum Test Frequency</u>
Subgrade & Embankment	Moisture-Density Curve	1 per soil type
Compaction	In-Place Density	1/6000 sq.ft./lift
Aggregate Base Course or Subbase Course	Gradation, Plasticity Index, Liquid Limit	1/1000 ton or fraction thereof on each class
	Moisture-Density Curve	1/source on each class
Hot Bituminous Pavement	Asphalt Content	1/500 tons or 2 per project, whichever is greater
	Gradation	Aggregate-Minimum of 2/source

203.0 ROADWAY EXCAVATION AND GRADING: This work shall consist of excavation, disposal, shaping or compaction of all material encountered within the limits of the roadway in close conformity with the lines, grades and typical cross sections shown on the plans or as directed by the Engineer.

203.1 CLEARING: Excavation and grading for street improvements and paving projects shall include removal of trash, rubbish and low lying vegetation in the construction area. All vegetation and objects designated to remain shall be protected from injury or defacement.

203.2 GRUBBING: All vegetation such as trees, stumps, hedges, shrubs, brush, heavy sod, heavy growth of grass, decayed vegetable matter, rubbish and other unsuitable material within the area of excavation or upon which embankment is to be placed shall be stripped or otherwise removed to a depth of six (6) inches. All such materials shall be wasted or spread outside the construction area or disposed of as directed by the Engineer. In no case shall such objectionable material be allowed in or under embankment.

Except in areas to be excavated, stump holes and other holes from which obstructions are removed, shall be backfilled with suitable material and compacted in accordance with these specifications.

203.3 STRIPPING: Stripping shall consist of removing unsuitable overburden material before removal of other material for use in the roadway. All areas to be graded and all embankments or fill areas under paved slabs shall be stripped.

203.4 EXCAVATION: After all clearing, grubbing and stripping has been done, excavation of every description and of whatever materials encountered within the grading limits of the project shall be performed. All suitable excavated materials shall be transported to and placed in embankments or fills within the limits of the work.

The excavation and embankments for the roadway and ditches shall be finished to reasonably smooth and uniform surfaces. Variation from the subgrade plane shall not be more than 1" unless approved by the Engineer. Excavation operations shall be conducted so that material outside of the limits of slopes will not be disturbed, but all cuts shall be made to subgrade a minimum of 1 foot outside the proposed edge of pavement or curb. Prior to beginning grading operations in any area, all necessary clearing and grubbing in that area shall have been performed. The Contractor shall not excavate beyond the dimensions and elevations established, and material shall not be removed prior to the staking.

If excavation to the finished graded section encounters a subgrade or slopes of spongy material, vegetable matter or trash pockets, or standing water, the Engineer may require the Contractor to remove the unsuitable materials and backfill to the finished graded section with suitable material. Subgrade stabilization material (Type 1, Aggregate Classification Table) may be used to backfill the excavations of unsuitable material. The Engineer may designate as unsuitable those soils or materials that are in his judgment detrimental to the finished roadway. All unsuitable material shall be disposed of outside the construction area.

203.5 SHOULDERING AND MISCELLANEOUS WORK: The Contractor shall deposit sufficient suitable earth between curb and sidewalks, or property lines, so that when smoothed and consolidated in final deposition, it will provide a uniform smooth slope from top of curb to the adjacent sidewalk or property line. All broken concrete, trash and debris shall be removed before any fill is placed back of curb. In case excavation is necessary to accomplish the above purpose, the Contractor shall make such necessary excavation, and he shall leave the parking area so filled or excavated free from all trash and debris.

The Contractor shall set all manholes, water boxes or other service boxes, to the proper finished grade of the pavement or of the fill back of the curb. This work will be considered as part of the grading.

204.0

EMBANKMENTS: Embankment construction shall consist of constructing roadway embankments, including preparation of the areas upon which they are to be placed; the construction of dikes; the placing and compacting of approved material within project areas where unsuitable material has been removed; and the placing and compacting of embankment material in holes, pits and other depressions within the project area. Only approved materials shall be used in the construction of embankments and backfills.

Free running water shall be drained from the material before the material is placed. Rocks, broken concrete or other solid materials more than 6" in greatest dimension shall not be placed in embankment areas higher than 1 foot from the finished subgrade. Materials up to 150 pounds in weight may be placed at the lower area of fills when they will lie 3 feet below the finished subgrade. All fill material shall be free from roots, organic material, trash and frozen material.

When an embankment is to be placed and compacted on hillsides, or when new embankment is to be compacted against existing embankments, or when embankment is built 1/2 width at a time, the slopes that are steeper than 4:1 when measured longitudinally or at right angles to the roadway shall be continuously benched over those areas where it is required as the work is brought up in layers. Benching shall be well keyed and where practical a minimum of 8 feet wide. Each horizontal cut shall begin at the intersection of the original ground and the vertical sides of the previous cuts. Material thus cut out shall be recompacted along with the new embankment material at the Contractor's expense.

Embankment material shall be placed in horizontal layers not to exceed 8 inches in loose depth and compacted prior to placing each following layer.

The Contractor shall add moisture to or dry by aeration each layer as may be necessary to meet the requirements for compaction. Materials shall not be placed in embankments or fills when the moisture content exceeds 5% above or is 3% below optimum moisture content for that material. Under roadways and extending one (1) foot beyond proposed curb line measured perpendicular from the centerline embankments shall be compacted for the entire depth of the fill to a density of not less than 93% maximum dry density as measured by AASHTO T 180.

205.0

SUBGRADE PREPARATION: After all necessary grading has been done to bring the surface to the subgrade, the subgrade shall be scarified and compacted to a depth of 8 inches. The entire road bed width, 8 inches deep, shall be compacted to a density of not less than 93% of maximum dry density as measured by AASHTO T 180. If necessary, subgrade stabilization material may be used to achieve the specified compaction. Failure to attain the specified density shall be cause for rescarifying and recompacting.

Base or subbase shall not be placed upon the subgrade or any previously placed layer of the pavement section until compaction tests are taken

and approved by the Engineer. Testing shall include but not be limited to trenches for water, sanitary, storm, telephone, gas, electric and around manholes, valve boxes, or inlets. After the specified compaction density is approved by the Engineer, the subgrade shall be struck off and rolled with a smooth roller to the exact cross section as shown on the plans.

206.0 BASE COURSE AGGREGATE: Aggregates shall be crushed stone, crushed slag, crushed gravel or natural gravel which conforms to the requirements of AASHTO M 147. Aggregate shall meet the grading requirements in the Classification Table below. The type used shall be specified on the plans or special provisions. The liquid limit (LL) shall be as shown in the table and the plasticity index (PI) shall not exceed 6 when the aggregate is tested in accordance with AASHTO T 89 and T 90, respectively.

In advance of the beginning of placing any aggregates, the Contractor shall submit suitable samples of the proposed material to an approved Materials Testing Laboratory for tests to determine the compliance with the requirements of this specification. The results of all tests shall be submitted to the Engineer for approval prior to the placement of any aggregate material. Tests shall be at the Contractor's expense.

CLASSIFICATION TABLE FOR AGGREGATE BASE COURSE

Sieve Designation	Percentage by Weight Passing Square Mesh Sieves						
	LL not greater than 35			LL not greater than 30			
	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7
4 inch	...	100	...	...	...	...	...
3 inch	...	95-100	...	...	...	...	...
2½ inch	100	...	...	...	...	...	...
2 inch	95-100	...	...	100	...	...	...
1½ inch	...	...	...	90-100	100	...	...
1 inch	...	...	...	...	95-100	...	100
¾ inch	...	...	...	50-90	...	100	...
No. 4	30-65	...	...	30-50	30-70	30-65	...
No. 8	...	...	...	...	...	25-55	20-85
No. 200	3-15	3-15	20 max.	3-12	3-15	3-12	5-15

Note: Class 3 material shall consist of bank or pit run material

207.0

BASE COURSE PLACEMENT AND COMPACTION: The subbase course material shall be placed on the previously prepared subgrade. Subgrade shall be graded and rolled to a smooth and uniform surface free of cracks and soft spots with approximate optimum moisture obtained immediately prior to placement of subbase. The base course material shall be placed on the previously prepared subbase at the locations and in the proper quantities to conform to the typical cross sections as shown on the plans and as directed by the Engineer. Placing and spreading shall be done by means of spreader machine, moving vehicle, motor grader or other approved equipment methods. The material shall be placed without segregation. Any segregated areas shall be removed and replaced with uniformly graded material at the Contractor's expense.

Each layer of subbase material shall be placed in layers not to exceed eight (8) inches in loose depth. Each layer shall be wetted or aerated, if necessary, and compacted to not less than 95% of maximum density as determined by AASHTO T 180, Method D (Modified Proctor). If water is needed, it shall be uniformly applied as necessary during compaction to obtain optimum moisture content and to aid in consolidation. The surface of each layer shall be maintained during the compaction operations in such a manner that a uniform texture is produced and the aggregates are firmly keyed. No subbase material shall be placed upon a soft, spongy or frozen subgrade or other subgrade, the stability of which is, in the opinion of the Engineer, unsuitable for the placement thereof.

The above specifications are required for the placement and compaction of the base course material with the exception that each layer of base course material shall have a thickness not to exceed 6 inches when compacted.

The finished base course surface shall be smooth and free of ruts and irregularities and true to grade and crown as shown on the plans or as directed by the Engineer. The final surface shall be finished with a surface smoothness tolerance of one-fourth inch (1/4") measured as vertical ordinate from the face to a ten-foot straightedge laid parallel or 3/8" perpendicular to the station line. The base course shall be maintained in this condition by watering, drying, rolling or blading, as necessary until the surfacing is placed.

In-place field density determinations shall be made in accordance with AASHTO T 191 or T 205. The use of a nuclear density gauge will be allowed when correlated with one of the above test methods.

208.0

PLANT MIX HOT BITUMINOUS PAVEMENT: The bituminous pavement shall be composed of a mixture of aggregate, filler if required, and bituminous material, hot mixed at a central plant and placed on the prepared base in conformity with the cross section and grades shown on the approved plans.

208.1

TESTING: The Contractor, at his expense, shall submit suitable samples of all materials proposed for use on the project to a materials testing

laboratory approved by the Engineer. The Testing Laboratory shall, at the Contractor's expense, test all materials for compliance with these specifications and establish a job mix formula for each mixture proposed for use on the project.

The job mix formula for each mixture shall establish a single percentage of aggregate passing each required sieve size, a single percentage of bituminous material to be added to the aggregate, and a single temperature at which the mixture is to be mixed. The job mix formula shall be within the master range specified in the following subsection. The job mix formula may be derived by either the Marshall (ASTM 1559) (AASHTO T 245) or the Hveem methods (AASHTO T 246) (ASTM 1560) but shall employ all current, applicable AASHTO, ASTM or Asphalt Institute procedures. An immersion compression test (AASHTO T 165) will be performed on a sample made at the optimum asphalt cement content to determine the effect of water on the cohesion of the compacted bituminous mixture.

The aggregate source is undesignated but test results proving that the aggregate meets these specifications must be submitted to the Engineer with the job mix formula. The aggregate must be tested for size and grading, cleanliness and soundness, toughness, surface texture and particle shape, absorption and stripping potential using current, applicable AASHTO, ASTM and/or Asphalt Institute procedures.

Test results must be submitted to the Engineer before paving is to begin and his approval must be obtained in writing before any paving is begun.

Job mix formula testing will not have to be conducted for each new paving project if a mix formula conforming to these specifications has previously been established using the same aggregate source that the Contractor is proposing for this project. The test results and mix formula from the earlier lab tests shall then be submitted to the Engineer for approval before paving begins.

However, a written statement is required with the job mix submittal from the lab performing the earlier tests verifying that: (1) the Contractor's proposed aggregate is the same as that of the previously established mix formula and (2) the performance of the two mixes, produced under similar conditions, will essentially be the same, with proper allowances for testing deviation.

Should a change in sources of materials be made, a new job-mix formula shall be established before the new material is used. When unsatisfactory results make it necessary, the Engineer may require the Contractor to establish a new job-mix formula.

208.2 MATERIALS:

208.2a Asphalt - Asphalt cement shall adhere to the requirements of viscosity grade AC-10 as specified by AASHTO M 226, Table 1 unless otherwise permitted by the Engineer in writing.

208.2b Prime Coat Asphalt - Cutback asphalt for prime coat shall be MC-70 complying with the requirements of AASHTO M 82. Emulsified asphalt may be substituted where special construction methods, as outlined in 209.1, are followed. Emulsified asphalt shall conform to those requirements specified under 208.25 Tack Coat.

208.2c Tack Coat - Emulsified asphalt for tack coat shall be SS-1, SS-1h, CSS-1 or CSS-1h diluted one part water to one part emulsified asphalt. Before dilution the emulsified asphalt shall comply with the requirements of AASHTO M 140 or M 208.

208.2d Aggregate - Mineral aggregate shall consist of hard, durable particles or fragments of crushed stone or gravel which shall be free from disintegrated stone, vegetable matter, clay lumps or other deleterious substances. Aggregate shall conform to the following grading limits (Grading C):

<u>Sieve Size</u>	<u>Percent by Weight Passing Square Mesh Sieves</u>
3/4"	100
1/2"	70-95
3/8"	60-88
#4	44-72
#8	30-58
#30	12-34
#200	3-9

The aggregate shall also conform to the following requirements:

- Percentage of wear, Los Angeles Test (AASHTO T 96), not more than 35.
- At least 90 percent of the gravel retained on the No. 4 sieve shall have at least two fractured faces.
- When tested for stripping potential (AASHTO T 182), aggregate shall have a retained bituminous film of above 95 percent.
- Plasticity index shall not exceed 6 when the aggregate is tested in accordance with AASHTO-T 90.

208.2e MINERAL FILLER: If mineral filler is required to meet gradation or strength requirements, finely powdered limestone, Portland cement, hydrated lime or other approved materials may be used for the filler.

208.3 JOB MIX: The job mix for the asphalt-aggregate mixture shall meet the following criteria by testing method:

The exact percentage of asphalt cement in the job mix shall be determined by the testing laboratory for the aggregate to be used on the project. The percentile will vary between 4 and 7 percent. The amount of filler or anti-stripping agent, if necessary, will be determined by the testing laboratory. The stability will be at least 1500 pounds. Per cent airvoids will be between 3 and 7. The flow value will be between 8 and 16.

All mixtures furnished for the project shall conform to the job-mix formula within the following ranges of tolerances:

Passing No. 8 and Larger Sieves*	+/- 8 percent
Passing Sieves Smaller than No. 8 to larger than No. 200	+/- 6 percent
Passing No. 200 Sieve	+/- 3 percent
Bitumen	+/- 0.5 percent
Temperature of Mixture when emptied from Pugmill Mixers	+/- 20°F

*Exclusive of the maximum size designated in the job-mix formulas.

Any variation from the job-mix formula in the grading of the aggregate or in the asphalt content greater than the tolerances shown above shall be investigated and the conditions causing the variation corrected.

209.0

CONSTRUCTION REQUIREMENTS:

209.1

PREPARING AREA TO BE PAVED: The area to be paved shall be substantially true to line and grade. It shall have a dry, firm and properly prepared surface before paving operations begin. Prime coat shall be applied uniformly at a rate of 0.25 gallons per square yard to the surface of aggregate base course prior to placement of hot bituminous pavement. The prime coat shall be sprayed at a temperature of between 120°F and 130°F. Where emulsified asphalt is applied as a prime coat, it shall be applied to finished base course prior to compaction. It shall be applied at a rate of 0.3 gallons per square yard. The surface shall be rolled and compacted after placement of emulsified asphalt. Emulsions may be used when air temperature is above 60°F and where application of asphalt paving will be completed within 24 hours of placing of prime coat.

If new asphalt is to be placed over existing asphalt, holes and depressions in existing surfaces shall be repaired by removing all loose and defective material to sound pavement or base and applying prime coat and replacing with an asphalt-aggregate patching material. The patching mixture shall be compacted to produce a tight surface conforming to the adjacent pavement area. If there is excess asphalt

in existing patches or joints, it shall be removed and made level with the surrounding pavement grade.

A tack coat shall be applied uniformly at the rate of 0.10 gallons per square yard between layers of hot bituminous pavement (either between new layers or existing and new layers). Likewise, surfaces of curbs, gutters, vertical faces of existing pavements, and all structures to be in actual contact with the asphalt-aggregate mixture shall be given a thin, even coating of asphaltic material. Care shall be taken to prevent splattering, with asphalt, surfaces that will not be in contact with the asphalt-aggregate mixture. Immediately prior to application of the asphalt tack coat, all loose and foreign material shall be removed by sweeping or by blowing, or both.

209.2 **BITUMINOUS MIXING PLANT:** The aggregate shall be dried and heated to provide a paving mixture temperature in conformance with placing conditions, but not to exceed 163°C (325°F).

The heated and dried aggregates shall not contain enough moisture to cause the mixture to slump, the asphalt to foam, or the aggregate to segregate during hauling and placing, or to interfere with the proper adhesion of the asphalt aggregate mixture.

Mixing time shall be the shortest time that will produce a satisfactory mixture. It will be established by the contractor based on the procedure for determining the percentage of coated particles described in AASHTO Method T 195 (ASTM Method D 2489). The mixing times will be set to achieve 95 percent of coated particles for all mixtures.

The aggregates shall be combined in the mixer in the amount of each fraction of aggregates required to meet the job-mix formula. The bituminous material shall be measured or gauged and introduced into the mixer in the amount specified by the job-mix formula.

The job-mix temperature at the mixer discharge (for pugmill or dryer drum) shall be between 245°F and 300°F. Mixtures shall be delivered for use on the road at not less than 235°F nor greater than 290°F. The mixture shall be hauled in such a manner so that it is protected from the weather and so that the minimum temperature stated above is maintained until the mixture is unloaded into the paver.

209.3 **MIXTURE PLACEMENT:** The asphalt mixture shall be placed by bituminous pavers which shall be self-contained, power-propelled units, provided with an activated screed or strike-off assembly, heated if necessary, and capable of spreading and finishing courses of bituminous plant mix material in widths applicable to the specified typical section and thicknesses shown on the plans.

The paver shall be equipped with a receiving hopper having sufficient capacity for a uniform spreading operation. The hopper shall be equipped with a distribution system to place the mixture uniformly in front of the screed.

The paving machine shall be equipped with an automatic control system which will control the elevation of the screed and which is automatically actuated by a system of sensor-operated devices which sense and follow reference lines or surfaces on one or both sides of the machine as required.

The screed shall be maintained at the proper elevation at each end by controlling the elevation of one end and automatically controlling the transverse slope or by controlling the elevation of each end independently, as directed.

The screed or strike-off assembly shall effectively produce a finished surface of the required evenness and texture without tearing, shoving or gouging the mixture.

When laying mixtures, the paver shall be capable of being operated at forward speeds consistent with satisfactory laying of the mixture.

Rollers shall be of the steel wheel, vibratory, pneumatic tire type or combination and shall be in good condition, capable of reversing without backlash.

The base course mixture shall be placed in one or more lifts with an asphalt paver to provide a nominal compacted thickness. The minimum lift thickness shall be at least two times the maximum particle size. The maximum lift thickness shall be that which can be demonstrated to be laid in a single lift and compacted to required uniform density and smoothness.

Placing the mixture shall be a continuous operation. If any irregularities occur, they shall be corrected before final compaction of the mixture.

The minimum ambient temperature at the time of placement shall be 50°F unless specifically approved by the City Engineer. No asphalt shall be laid on a wet or damp base. The Engineer shall determine if the base is suitable for placement.

The longitudinal joint in one layer shall offset that in the layer immediately below by approximately 6 inches; however, the joints in the top layer shall be located as follows:

For 2-lane roadway, at the centerline of the pavement and at the outside edge of the travel lanes.

On areas where irregularities or unavoidable obstacles make the use of mechanical spreading or finishing equipment impracticable, the mixture shall be spread, raked and luted by hand tools. For such areas, the mixture shall be dumped, spread and hand screeded to give the required compacted thickness.

209.4 **COMPACTION:** The mix shall be compacted immediately after placing. Initial rolling shall follow the paver as closely as possible. If needed, intermediate rolling with a pneumatic-tired roller shall be done immediately behind the initial rolling. Final rolling shall eliminate marks from previous rolling. In areas too small for the roller, a vibrating plate compactor or a hand tamper shall be used to achieve thorough compaction.

The surface shall be rolled when the mixture is in the proper condition and when the rolling does not cause undue displacement, cracking or shoving. Unless otherwise directed, rolling shall begin at the sides and proceed longitudinally parallel to the road center line, each trip overlapping one-half the roller width, gradually progressing to the crown of the road.

Any displacement occurring as a result of the reversing of the direction of the roller, or from other causes, shall be corrected at once by the use of rakes and addition of fresh mixture when required. Care shall be exercised in rolling not to displace the line and grade of the edges of the bituminous mixture.

To prevent adhesion of the mixture to the rollers, the wheels shall be kept properly moistened with water. Use of excess water will not be permitted.

Any mixture that becomes loose and broken, mixed with dirt, or is in any way defective shall be removed and replaced with fresh hot mixture, which shall be compacted to conform with the surrounding area. Any area showing an excess or deficiency of bituminous material shall be removed and replaced.

209.5 **JOINTS:** Placing of the bituminous paving shall be as continuous as possible. Rollers shall not pass over the unprotected end of a freshly laid mixture unless authorized by the Engineer. Transverse joints shall be formed by cutting back on the previous run to expose the full depth of the course. A coat of bituminous material shall be used on contact surfaces of all joints just before additional mixture is placed against the previously rolled material.

209.6 **SURFACE TOLERANCES:** The variation between any two contacts with the surface shall not exceed 3/16 inch in 10 feet. All humps or depressions exceeding the specified tolerance shall be corrected by removing defective work and replacing it with new material or by overlaying (patching) as directed by the Engineer. The final pavement surface shall not vary from the theoretical cross section by more than one (1) inch at any one point.

The final surface pavement adjacent to concrete gutter shall be finished from 1/8 inch to 3/8 inch above the lip of the gutter into which it drains.

Any surface pavement that is above the lip more than 3/8 inch shall be removed and replaced to the specified height. Any surface pavement that is below the lip of the gutter shall be corrected as specified above.

209.7 MANHOLES AND VALVE BOXES: All manholes and valve boxes shall be brought to finished grade by the Contractor before the surface course is placed. The Engineer shall inspect all manholes and valve boxes. The Contractor shall remove any foreign matter introduced into them by his work. It shall also be the Contractor's responsibility to insure proper compaction around all manholes and valve boxes after they have been raised. As an alternate, valve boxes and manholes may be raised after completion of the final lift and backfilled. Asphalt shall be neatly cut with a saw to provide a square cutout. Dimension of the cutout shall be 30" square on water valve boxes and 48" square on manholes. Boxes and manholes shall be centered on the cutouts. Concrete for the cutouts shall be as shown on the detail sheet.

210.0 ACCEPTANCE REQUIREMENTS: In addition to all other required tests described in previous sections, acceptance of paving will be based upon density tests conducted by an Engineer approved testing laboratory. The temperature of the asphalt material will be measured and recorded by the Contractor as the mixture is being placed. A sufficient number of samples shall be chosen at random at the job site to perform an asphalt content (extraction) test, (AASHTO T 164), aggregate grading of the extracted aggregate (AASHTO T 30) and laboratory compaction of at least 3 briquettes in accordance with ASTM D 1559 (AASHTO T 245).

The briquettes will be tested by the Marshall Method (AASHTO T 245) to determine the amount of voids, stability and flow of the compacted mixture. A specific gravity and unit weight of the briquettes will be determined (AASHTO T 166) to compare with the in-place density.

After the asphalt pavement has been rolled and has cooled, two four-inch diameter cores will be sampled from that mat. These cores will be measured for thickness and density (AASHTO T 230). This density will be compared to the density of the Marshall briquettes to determine the percent compaction of the cores.

As an alternative to core sampling, the compacted layers of asphalt can be tested for density using a nuclear device in accordance with ASTM D 2950.

Each day's paving and each layer of compacted asphalt will be tested as specified above. For acceptance by the City, the average of the field density determinations must be equal to or greater than 94 percent, with no individual determination being lower than 93 percent, of the average density of the laboratory-prepared specimens.

211.0 INSPECTION AND ACCEPTANCE OF WORK: The City Engineer, or his duly authorized representative, shall at all times have access to the work during its construction. All work done and all materials furnished

shall be subject to his inspection and approval. Work and materials not meeting the requirements shall be made good, and unsuitable work or materials may be rejected. All work which has been rejected shall be remedied, or removed and replaced in an acceptable manner.

When the City Engineer has made a final inspection and determines that the work has been completed in all respects, and after as-built drawings are submitted, he will formally accept in writing the improvements.

CONTRACTORS' GUARANTEE: The Contractor shall guarantee all portions of street construction for a period of one year after acceptance by the Engineer against defective workmanship and materials and shall keep same in good order and repair. The determination of the necessity, during such guarantee period, for the Contractor to repair said street, or any portion thereof, shall rest entirely with the City Engineer, whose decision upon the matter shall be final and obligatory upon the Contractor.

SECTION 300

STANDARD SPECIFICATIONS FOR CONSTRUCTION

CONCRETE CURB, GUTTER AND SIDEWALK CONSTRUCTION

300.0 GENERAL: This section covers the criteria to be used for the construction of curbs, gutters, sidewalks, driveway approaches and cross gutters.

301.0 SEQUENCE OF CONSTRUCTION: In areas of new development or other areas where utility lines have not been installed, all curb, gutter and sidewalk shall be constructed only after installation of sanitary sewer, storm sewer, water, gas, electric, telephone and television lines have been completed and properly compacted in accordance with applicable sections of these specifications.

Prior to any excavation, the Contractor shall inspect the location of proposed sidewalks and determine where tree roots may be encountered during excavation for sidewalk construction. The Contractor shall notify the City Parks and Recreation Department prior to beginning construction when it appears that tree roots may be encountered during excavation.

When tree roots are unexpectedly encountered during construction, the Contractor shall discontinue work in the area where roots are encountered and shall contact the City Parks and Recreation Department who shall determine what steps to take to preserve the trees and the future sidewalk.

302.0 PERMITS: Permits shall be obtained before work begins. Contractor shall call for inspection, giving 24 hours notice, and inspection shall be made before placement of concrete can occur.

Inspector's approval to place materials shall be obtained by Contractor after inspection has been made and before concrete is placed.

Notice of rejection shall be given to the Contractor in the event any of the aforementioned conditions are not met, and work shall be halted until such time as corrective action is taken.

Copies of the approved drawing and the permit shall be on the job site and available to the Inspector at all times.

303.0 MATERIALS

303.01 CEMENT: Cement used shall conform to the Standard Specification for Portland Cement (AASHTO M 85), Type I, IA, II or IIA. When approved by the Engineer, Type III or IIIA, High Early Strength cement may be used.

303.02 CONCRETE: Concrete shall be composed of cement, coarse and fine aggregate, water and entrained air. The concrete shall contain a minimum of six (6) sacks of cement per cubic yard, a maximum of six (6) gallons of water per sack of cement, and air content of $6\frac{1}{2}\% \pm 1\frac{1}{2}\%$ by volume and a maximum coarse aggregate size of $1\frac{1}{2}$ inches. The laboratory design concrete shall have a minimum compressive strength at 28 days of 3,750 psi. Either sacked or bulk cement may be used. No fraction of a sack of cement shall be used in a batch of concrete unless the cement is weighed. All bulk cement shall be weighed on an approved weighing device. Any admixture except air entraining agent must be approved by the Engineer, including accelerators retarders and fly ash. Air entraining admixtures shall conform to AASHTO M 154, latest edition.

Concrete shall have a slump of not less than one (1) inch nor more than four (4) inches when tested in accordance with Standard Method of Test for Slump of Portland Cement Concrete AASHTO T 119.

The use of calcium chloride in any concrete is prohibited unless approved in writing by the Engineer.

303.03 AGGREGATE: Coarse aggregate for concrete shall conform to the requirements of AASHTO M 80 having clean, hard, strong, durable pieces, free from adherent coatings and conforming to the following gradation:

<u>Sieve Designation</u>	<u>1½" Coarse Aggregate Percent Passing</u>	<u>¾" Coarse Aggregate Percent Passing</u>
2 Inch	100	100
1½ Inch	90 - 100	100
1 Inch	20 - 55	100
¾ Inch	0 - 15	90 - 100
¾ Inch	0 - 5	20 - 55
No. 4		0 - 10
No. 8		0 - 5
¾ Inch	0 - 5	20 - 55
No. 4	0 - 5	0 - 10
No. 8	0 - 5	0 - 5

Fine aggregate for concrete shall conform to the requirements of AASHTO M 6 and meeting the following gradation:

<u>Sieve Designation</u>	<u>Percent Passing</u>
¾ Inch	100
No. 4	95 - 100
No. 16	45 - 80
No. 50	10 - 30
No. 100	2 - 10

303.04 WATER: Water used for mixing or curing concrete shall be potable, clean and free from injurious amounts of oils, acids, salt, alkali,

organic materials or other substances that may be deleterious to the concrete.

- 303.05 EXPANSION JOINT MATERIAL: Expansion joint materials shall be $\frac{1}{4}$ inch thick non-extruding preformed joint filler and shall conform to AASHTO M 33.
- 303.06 PLASTIC FILM: Plastic film used for moisture retention during concrete curing shall have a minimum thickness of 4 mils, shall be black, white or clear in color and meet the requirements of AASHTO M 171.
- 303.07 CURING COMPOUND: Curing compound shall be white pigmented, liquid, membrane-forming compounds conforming to AASHTO M 148, Type 2, Class B (vehicle solids restricted to all resin material).
- 303.08 FORMS: Forms shall be metal or wood and shall have a depth equal to or greater than the section being placed. The supply of forms shall be sufficient to permit their remaining in place for a minimum of six (6) hours after the concrete has been placed. Each section of form shall be straight and free from warps and bends and of sufficient strength to resist the pressure of the concrete without springing. Bracing and staking of forms shall be such that the forms remain in both horizontal and vertical alignment until their removal. Maximum deviations of the top surface shall not exceed one-eighth (1/8) inch in ten (10) feet. The method of connection between sections shall be such that the joint thus formed is tight and free from movement in any direction. Care shall be taken in removing forms to prevent marring or spalling of the concrete.

The forms shall be thoroughly cleaned each time they are used and coated with an approved form-release agent which will not discolor or stain the concrete.

When pouring concrete gutter adjacent to existing asphalt paving, the edge of the asphalt may not be used as a form for the new concrete. The gutter shall be formed as described above and the pavement patched according to Section 314 upon completion of the concrete work.

- 303.09 AGGREGATE BASE COURSE: Aggregate base course, required under all curb, gutter and sidewalk installation shall consist of crushed stone or gravel, and shall conform to the requirements for Class 6, Aggregate Base Course as specified in the Colorado Division of Highways, Standard Specifications for Road and Bridge Construction, Section 703.03. Among other requirements, Class 6 Aggregate Base must meet the following gradation.

<u>Sieve Designation</u>	<u>Percentage Passing</u>
3/4 Inch	100
No. 4	30 - 65
No. 8	25 - 55
No. 200	3 - 15

304.0 TESTS: A series of concrete tests will be performed by an approved testing laboratory and the results submitted to the Engineer for approval before any curb and gutter and/or sidewalk project will be accepted by the City. The number of tests required will be as follows:

(a) Smaller projects - Under 30 lineal feet of installed curb, gutter and sidewalk or under 30 lineal feet of either installed curb and gutter or installed sidewalk. Slump and temperature test with certified statement of cement, water and aggregate content will be required.

(b) Larger projects - Each day of concrete pouring or for each 50 cubic yards of concrete poured, whichever is greater, a complete series of tests, all conducted according to current, applicable AASHTO or ASTM procedures are required:

1. Slump test, air content test will be performed and concrete temperature measurement taken during placement operations.

2. Comprehensive strength tests will be performed on four cylinders molded from fresh concrete at the project site. The cylinders will be cured in accordance with the latest issue of ASTM C-31. The compressive strength of one cylinder will be determined at seven days, two cylinders will be tested at 28 days and, if required by the Engineer, the last cylinder will be tested at 45 days. Compressive strength will be determined in accordance with the latest issue of ASTM C-39.

Failure of either of the 28-day cured cylinders to attain the required minimum strength will be cause for rejection of that portion of the project represented by the cylinders, removal and replacement of all installed concrete within the failed portion, and changes in the concrete mix preparations to meet the minimum strength requirements.

All gutter will be water flow tested by the Contractor in the presence of the Engineer for outflow and ponding when it has attained sufficient hardness to properly withstand the testing. Any section of soft curb and gutter or cross gutter, unauthorized areas of outflow, or areas of ponding deeper than $\frac{1}{4}$ inch shall be carefully cut out with a concrete saw between the nearest two contraction joints (or nearest contraction and expansion joints), removed and replaced to the proper grade and cross section to eliminate the outflow or ponding problem. Full cross section expansion joints will be placed between the sections of existing and new concrete curb and gutter. The work of removal and replacement of the curb and gutter will be at the Contractors' expense. The new sections will be retested by the Contractor in the presence of the Engineer or Inspector to assure that the problem is corrected.

305.0 AGGREGATE BASE COURSE PREPARATION: Immediately beneath all curb and gutter and/or sidewalk installations shall be placed a minimum of 4" of compacted Class 6 aggregate base. The subgrade shall be excavated to the necessary depth and width that will allow for placement of the

base material and permit the installation and bracing of the forms. If necessary, the subgrade shall be filled with base material in maximum of 6" lifts to bring it to the required lines and grades as shown on the approved plans. All debris, roots, vegetable matter, soft, yielding soil and other existing unsuitable subgrade material shall be removed to a depth of not less than six (6) inches below subgrade, or when required by the Engineer, to a greater depth and replaced with aggregate base. Compaction in all fill areas shall extend a minimum of one foot outside the form lines. The base course material shall be shaped and compacted to a firm, even surface.

It shall be compacted to at least 93% of AASHTO T 180 maximum density. If the Engineer or the Inspector has reason to believe that the required minimum compaction is not being attained on the base material, he may require, at the Contractor's expense, laboratory and in-place density tests using applicable, current AASHTO or ASTM procedures to be conducted by an Engineer approved testing lab on the base material. The test results will be submitted to and approved by the Engineer before the project will receive final acceptance by the City.

306.0 CONCRETE MIXING

306.01 JOB MIXED CONCRETE: When concrete is mixed at the site, cement must be Type IA or IIA.

All concrete shall be thoroughly mixed in a batch mixer of an Engineer approved type and capacity for a period of not less than two minutes after all the materials, including water, have been placed in the drum. During the period of mixing, the drum shall be operated at the speed specified by the manufacturer of the equipment. The entire contents of the mixer shall be discharged before recharge and the mixer shall be cleaned frequently. The concrete shall be mixed only in such quantities as are required for immediate use. Hand mixed concrete shall not be permitted except by written approval of the Engineer.

306.02 READY MIXED CONCRETE: At the option of the Contractor, ready-mixed concrete may be used in lieu of concrete mixed at the job. The use of ready mixed concrete in no way relieves the Contractor of sole responsibility for proportioning, mixing, delivering or lacing concrete as required in these specifications. Ready mixed concrete shall be continuously mixed or agitated from the time the water is added until the time of use. The concrete shall be completely discharged from the truck mixer or truck agitator within one and one-half hours after the cement comes in contact with the mixing water or with the combined aggregates containing free moisture in excess of 2% by weight. Retempered concrete shall be allowed.

The organization supplying ready-mixed concrete shall have sufficient plant and transportation facilities to assure continuous delivery of concrete at the required rate. The Contractor shall collect delivery or batch tickets from the ready-mix driver for each load of concrete

used on the project and submit them to the Engineer. Tickets shall show weight of all materials and additives used in each batch.

306.03 RETEMPERING OF CONCRETE: Retempering of concrete which has partially hardened by remixing, with or without water, will not be permitted.

307.0 PLACING CONCRETE: Before depositing concrete, debris shall be removed from the space to be occupied by the concrete, and the forms, base material and any existing concrete surface shall be thoroughly moistened immediately prior to placing of concrete. Concrete shall not be placed until all forms and compacted base course material have been inspected and approved by the Engineer or Inspector. The concrete shall be placed either by an approved slipform/extrusion machine, by the formed method, or by a combination of these methods. Concrete shall be handled from the mixer to the place of final deposit as rapidly as possible by methods which prevent separation or loss of ingredients. Conveying equipment shall be washed and kept clean at all times. Concrete shall be deposited in the forms as nearly in its final position as practicable to avoid rehandling.

Concrete shall be placed in a manner that will avoid segregation and shall not be dropped freely more than 5 feet. Necessary hand spreading shall be done with shovels and not with rakes. The concrete shall be tamped or mechanically vibrated for thorough consolidation but again without segregation of the mix. If vibrators are used, they shall be inserted and removed vertically at regular intervals to insure uniform consolidation. In no case shall vibrators be used to transport concrete inside the forms. If segregation occurs, the Engineer may require the affected concrete to be removed and replaced at the Contractor's expense.

308.0 SPACING OF JOINTS

308.01 EXPANSION JOINTS: Expansion joints shall be of $\frac{1}{2}$ inch thick non-extruding preformed joint filler material cut to the configuration of the full depth and width of the concrete section, except that joint filler shall be left $\frac{1}{4}$ " below the surface when joints are shown to be sealed in the plans.

Expansion joint material (filler) shall be placed prior to placing of concrete and shall be provided at the following locations:

- A. every 80 feet of curb and gutter and/or sidewalk
- B. at all sides of a curb return that will be adjacent to new or existing sidewalk
- C. at both edges of a driveway adjacent to any concrete
- D. between back of sidewalk and driveway slab or service walk
- E. between the sidewalk and any fixed structure such as a building or bridge
- F. at both ends of intersection radii
- G. around fire hydrants, poles or manholes
- H. as directed by the Engineer

Joint filler shall be secured and held in place during placing and consolidation of concrete.

- 308.02 CONTRACTION JOINTS: All curb, gutter and sidewalk shall be divided by transverse contraction joints at right angles to the curb line and at intervals not to exceed ten (10) feet. Joints shall be one-eighth (1/8) inch wide and shall extend to one-fourth of the concrete depth.

Contraction joints shall be sawed, formed by one-eighth (1/8) inch thick division templates, cut to the configuration of the concrete section, or hand-formed. Sawing shall be done within twenty-four (24) hours after the concrete has set to prevent the formation of uncontrolled cracks. Templates shall be secured to the forms so that they are not moved by placing and consolidation of concrete. Division templates shall be removed after the concrete has set and before final finishing. The joints may be hand-formed by using a narrow or triangular jointing tool to impress a plane of weakness into the concrete.

- 309.0 FINISHING: After the concrete has been leveled and the initial set has taken place, all exposed surfaces shall be carefully finished with wood or magnesium floats and steel trowels to a smooth but not slippery finish. Exposed faces of curbs and sidewalks shall be finished to true line and grade as shown on the approved plans. The final texture shall be made by drawing a broom, or brush, or burlap lightly across the surface.

Concrete that is adjacent to forms and all joints shall be edged with a 1/4 inch radius edging tool. Special care shall be taken to insure a straight, neat appearance along edges or sidewalks, slabs and joints. In addition, extra care shall be taken to insure that the slope of the curb and gutter meets the requirements of the specification drawings in the last section of this manual. No sections of outflow in the gutter cross sections will be allowed unless specifically authorized in the approved plans or approved by the Engineer.

Forms shall not be disturbed until the concrete has hardened sufficiently to hold its shape but forms shall be removed promptly thereafter to allow completion of curing operations. After removal of forms, all bulges, fins, form marks or other irregularities that may adversely affect the appearance or function of the concrete shall be removed. Also, honeycombed places and other minor defects shall be filled with mortar composed of one part Portland cement and two parts of fine aggregate, which shall be applied with a float. This plastering treatment is not allowed on the exposed face of any curb, gutter, sidewalk, or driveway.

- 310.0 FORMING MACHINE PLACEMENT: In lieu of the construction methods described in the preceding paragraphs, the Contractor may use a slipform/extrusion machine for construction of curb, gutter and sidewalk or any combination thereof. The machine shall place, shape, consolidate, screed and finish the full width and depth of the concrete

section in one complete pass. This shall be done in such a manner that a minimum of hand finishing will be necessary to provide a concrete section that is uniform in texture, shape and density. All operations of mixing, delivery and spreading concrete shall be coordinated to provide uniform progress, with stopping and starting of the machine held to a minimum. The concrete edges shall be straight, smooth and true. The concrete shall be a stiff (low slump) mix. Concrete finishers shall follow the machine to form joints and correct any imperfections in the finish as described in the preceding paragraphs.

311.0 CURING: After finishing operations have been completed and as soon as marring of the concrete will not occur, the entire surface of the newly placed concrete will be cured by protecting it against moisture loss, rapid temperature change, and from rain, flowing water and any mechanical injury for a period of not less than seven days after placement of Type I or II cement is used. The minimum curing period shall be five days if Type III, High Early Strength cement is used. Concrete shall be cured by only one of the following methods:

311.01 LIQUID MEMBRANE FORMING CURING COMPOUND: This compound must conform to the requirements of Subsection 2.3.3, ACI 308 (Recommended Practice for Curing Concrete). The curing compound shall be applied immediately after the water sheen has left the finished concrete. If there is a delay between the time that the surface water has disappeared and the time that the curing compound is applied, the concrete surface shall be kept continually moist by means of a fine water spray until the compound can be applied.

The compound shall be applied under pressure at the manufacturer's recommended rate (approximately 150 square feet per gallon) in a manner which covers the entire pavement with a uniform water-impermeable film. The rate will be sufficient to achieve the water retention as required in AASHTO M 148. The compound shall be kept agitated during application to prevent the pigment from settling.

311.02 PLASTIC FILM: Plastic film shall meet the requirements of AASHTO M 171 and Subsection 2.3.1, ACI 308 (Recommended Practice for Curing Concrete). In order to retain moisture in the concrete during the curing period, film shall be placed over the wet surface of the freshly finished concrete as soon as it can be done without marring the surface, and must extend at least twelve inches beyond the edges of all concrete to ensure complete coverage. The sheets shall be lapped at least 12 inches and the laps shall be secured in such a manner that they do not open up or separate. If there is a delay of placing the film immediately after concrete finishing, all exposed concrete surfaces shall be kept continually moist by means of a fine water spray until they can be covered by plastic film.

Windrows of sand or earth, or strips of wood shall be placed along all edges of the film to prevent wind from getting under the film and removing it. Film with holes or tears will not be used to cover the concrete and if, at any time during the required curing period holes

or tears develop in the film, that section of film will immediately be removed, all concrete surfaces under the removed film will be remoistened with a fine water spray, and the concrete will be completely covered and weighted with new undamaged film.

312.0

COLD WEATHER CONCRETING: Concrete shall not be placed when stormy or inclement weather will prevent good workmanship. Whenever daily temperatures are below 40°F or are expected to fall below 40°F, special cold weather provisions are required to protect the concrete from freezing and ensure satisfactory strengths during placement and curing operations. Generally, the recommendations of American Concrete Institute, Section 306 shall be followed.

Any curb, gutter and/or sidewalk poured with Type IA or IIA concrete will be placed, protected and maintained at a minimum temperature of 55°F for six days. Type IIIA (High Early Strength) concrete will be placed, protected and maintained at a minimum temperature of 55°F for four days. Additional temperature requirements are shown in the table below.

TEMPERATURES FOR CONCRETE PLACED AND CURED IN COLD WEATHER

Minimum Temperature of Fresh Concrete as Mixed for Weather Below 40°F	Above 30°F 0°F to 30°F Below 0°F	60°F 65°F 70°F
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Minimum Temperature of Fresh Concrete After Placing and For Protection Period	55°F
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Concrete should always be placed at near the lowest allowable temperature. Temperatures exceeding the minimum placement temperature by more than 10°F should be avoided. If hot water above 100°F is required to heat the concrete mix, care will be taken to prevent it from coming into contact with fresh cement to ensure that "flash set" will not occur. Heating equipment or methods which alter or prevent the entrainment of the required amount of air in the concrete shall not be used.

All snow, ice and frost must be removed from the intended location before concrete placement and no concrete shall be placed on frozen subgrade material. The subgrade shall be thawed by heating or insulation material placement, if necessary, prior to concrete placement. The thawed material will be recompact, if necessary.

The application of either liquid membrane curing compound or plastic film in accordance with curing requirements of this section will not be sufficient for cold weather protection. Any cold weather protection measures will be in addition to the curing protection.

Any form of protection recommended by and meeting the requirements of ACI 306, Cold Weather Concreting, will be acceptable including

insulative pads, straw, or heated enclosures. However, any protection must be sufficient to maintain the concrete at the minimum temperature during the required protection period. Failure to maintain the proper temperature shall be cause for rejection and replacement, at the Contractor's expense, of the curb and gutter and/or sidewalk.

The Engineer will measure and record the concrete temperature at least once a day during the protection period. The temperature will be obtained by placing a thermometer against the concrete under a temporary cover of heavy insulating material until it registers constant temperatures.

- 314.00 OPENING TO TRAFFIC: It shall be the Contractor's responsibility to protect the concrete being cured from the elements, traffic and vandalism. Inadequate protection by the Contractor shall be cause for suspension of concreting operations and damaged concrete shall be removed and replaced at the expense of the Contractor.

Sidewalks shall not be opened to pedestrian traffic for at least 24 hours after placement. New concrete shall not be opened to vehicular traffic for at least 7 days after placement. Additional time may be directed by the Engineer. The Contractor shall maintain suitable barricades to comply with this requirement.

- 315.00 DAMAGE TO EXISTING PAVEMENT: Existing asphalt pavement which is damaged during curb and gutter construction shall be repaired at the Contractor's expense. All jagged rough edges or cracked pavement shall be separated and removed from sound, undamaged asphalt by means of an asphalt cutter making straight, sharp cuts. If the base course has been damaged or soaked due to the concrete construction operations, it shall be removed, replaced and/or recompacted. The exposed base course, asphalt cuts and gutter face to be in contact with pavement shall be painted with hot asphalt cement immediately prior to the placement and compaction of hot asphalt mix. Cold asphalt mix will be allowed only if hot mix is not available. In either case, a minimum of 3 inches of asphalt mix will be required.

The surfaces of the new and existing asphalt shall match after compaction and new asphalt shall be $\frac{1}{4}$ " to $\frac{1}{2}$ " higher than the adjacent gutter surface.

- 316.00 REPAIRS OF EXISTING SIDEWALKS: Where repairs are made in existing sidewalks, all edges of the old sidewalk allowed to remain shall be saw cut to a minimum depth of $1\frac{1}{2}$ inches. No rough edges will be permitted where new construction joins old. Unless directed by the Engineer, no section less than 6 feet in length shall be placed or left in place. Where new sidewalk construction abuts existing sidewalks, the work shall be accomplished so that no abrupt change in grade between the old and new sidewalk results.

- 317.00 BACKFILLING: When side forms are removed, the space adjoining the concrete shall be promptly backfilled with suitable material, properly

compacted and brought flush with the surface of the concrete and adjoining ground surface. In embankments, the backfill shall be level with the top of the concrete for at least two (2) feet and then sloped to the property line.

318.00 ACCEPTANCE BY CITY: The Contractor will notify the Engineering Department at least 24 hours before any concrete is placed so that the Inspector may inspect the forms and base course before concreting operations begin. After or during finishing and curing procedures are completed, a final inspection will be made to verify compliance with remaining specifications. Deficiencies will immediately be repaired or replaced at the Contractor's expense. Upon receipt of satisfactory laboratory test results (including 28 day field cured cylinder compressive tests) the Engineer will issue a written acceptance of the project.

The Contractor shall guarantee all installed curb, gutter, sidewalk, and cross gutter for a period of one year after acceptance by the Engineer against defective workmanship and materials. The determination of the necessity, during such guarantee period, for the Contractor to repair or replace said curb, gutter, sidewalk, and cross gutter, or any portion thereof, shall rest entirely with the Engineer, whose decision upon the matter shall be final and binding upon the Contractor.



SECTION 400

STANDARD SPECIFICATIONS FOR CONSTRUCTION

CONCRETE STRUCTURES

401 STRUCTURES, CAST IN PLACE CONCRETE

401.1 SCOPE

All cast-in-place concrete culverts, retaining walls, abutments, piers, footings, foundations and similar structures shall conform to the requirements specified herein. Furnishing materials, mixing, transporting, placing, finishing, curing and other appurtenant items of the structures are included.

401.2 QUALITY STANDARDS

AASHTO M 33: Preformed Expansion Joint Fillers for Concrete (Bituminous Type)

AASHTO M 85: Portland Cement, Magnesium Oxide

AASHTO M 148: Liquid Membrane Forming Compounds for Curing

AASHTO M 153: Preformed Sponge Rubber and Cork Expansion Joint Filler for Concrete Paving and Structural Construction.

AASHTO M 154: Air Entraining Admixtures for Concrete

AASHTO M 157: Specifications for Ready-Mixed Concrete

AASHTO M 171: Concrete Sheet Materials for Curing Concrete

AASHTO M 213: Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction

AASHTO M 240: Blended Hydraulic Cement

ASTM C 94: Specifications for Ready-Mixed Concrete

ASTM C 138: Test for Weight Per Cubic Foot, Yield and Air Control

ASTM C 143: Test for Slump of Portland Cement - Concrete

ASTM C 150: Portland Cement, Magnesium Oxide
ASTM C 172: Sampling Fresh Concrete

ASTM C 231: Test for Air Content of Freshly Mixed
Concrete by the Pressure Method

ASTM C 260: Air Entraining Admixtures for Concrete

ASTM C 595: Blended Hydraulic Cement

ASTM C 994: Preformed Expansion Joint Fillers for
Concrete (Bituminous Type)

ASTM D 1751: Preformed Expansion Joint Fillers for
Concrete Paving and Structural Construction

ASTM D 1752: Preformed Sponge Rubber and Cork
Expansion Joint Filler for Concrete Paving and
Structural Construction

401.3 SUBMITTALS

The Contractor shall submit the following:

- 401.3.1 A Concrete mix designed by an independent laboratory, including strength tests of 3 cylinders proportioned to mix design formula, shall be submitted to the Engineer for approval, not less than 3 working days prior to scheduled pour.

Each truckload of concrete shall meet the following slump requirements as determined by the slump testing procedures in ASTM C 143. Slump tolerance shall be ± 1 inch. Slump shall be measured at point of incorporation into forms or discharged into pumping devices.

- a. Three inches slump for structural elements less than 12 inches and greater in thickness.
- b. Four inch slump for structural elements less than 12 inches in thickness and for all columns.

- 401.3.2 Certification of quality of all cement, mortar and grout mix design ingredients including admixtures with supporting test data and mill quality control results.

401.3.3 Certification of quality of all curing materials and proposed methods of use.

401.3.4 Trip tickets for each load of concrete. Tickets shall show weight of all materials and additives used, along with time water is added to each batch.

401.3.5 All other submittals shall be defined in the Special Provisions.

401.4 MATERIALS

The materials used in the concrete mix shall meet the requirements of one or more of the Quality Standards listed in Section 401.2.

401.4.1 CLASSES OF CONCRETE

The Class of concrete used shall be as defined on the Plans or in the Special Provisions.

401.4.1 CLASSES OF CONCRETE

The Class of concrete used shall be as defined on the Plans or in the Special Provisions

<u>CLASS</u>	<u>MINIMUM CEMENT LB./CU. YD</u>	<u>LABORATORY DESIGN MINIMUM STRENGTH AT 28 DAY COMPRESSIVE*</u>
A	550	3750 PSI
B	470	3125 PSI
C	420	2500 PSI

*Cured in accordance with ASTM C 31, latest edition

*Tested in accordance with ASTM C 39, latest edition

Class A concrete shall be used for concrete structures, either reinforced or non-reinforced.

Class B concrete may be used for manholes bases.

Class C concrete may be used for thrust blocks, encasements and fill of overexcavation.

401.4.3 AGGREGATES

Aggregates shall be crushed rock or gravel and sand-conforming to the requirements of section 303.

Aggregates for each batch of concrete shall be combined from materials separately stored in the various sizes and gradations required for the Concrete Mix Design. The maximum size aggregate used in the Concrete Mix Design shall not be larger than one-fifth (1/5) of the narrowest dimension between the forms or larger than three-fourths (3/4) of the minimum clear spacing between reinforcing bars.

Aggregate samples for the Concrete Mix Design test cylinders shall be taken by or in the presence of the Engineer. Sampling methods used shall not cause segregation, degradation proportions different than when required by the Concrete Mix Design.

401.4.4 ADMIXTURES

Only those admixtures specified in the Concrete Mix Design shall be used.

The use of calcium chloride shall not be permitted.

Air entrain all concrete to an air content between 4% and 6% by volume.

401.4.5 PROPORTIONING

All proportioning equipment shall comply with the Standards of the Concrete Plan Manufacturers Bureau. Proportioning shall consist of the process of combining the various sizes of aggregates with cement admixtures and water as required by the Concrete Mix Design.

401.4.6 MIXING

Machine mixing of all batches of concrete shall be required. The Engineer may authorize hand mixing of batches that do not exceed one-third (1/3) cubic yard.

Concrete transported in truck mixers or truck agitators shall be delivered to the site of the work and completely discharged within a period of ninety (90) minutes after the cement comes in contact with the mixing water or with combined aggregates containing free moisture in excess of 2% by weight.

401.4.7 Non-shrink, non-staining, premixed grout shall be used for equipment and column bases and for drilled in anchors. Grout shall be mixed in accordance with the manufacturer's recommendations.

Grout composed of 1 part Portland Cement to 3 parts sand (by volume) and of the driest possible consistency shall be used for filling voids, honeycombs or damaged areas. Aggregate proportions may vary slightly to provide a workable mix.

401.5 EXECUTION OF WORK

The subgrade shall be excavated or filled to the required grades and lines. All soft, yielding or

otherwise unsuitable material shall be removed and replaced with suitable material.

The subgrade shall be compacted to the density shown on the Plans and trimmed to provide a uniform surface at the correct elevation.

Each subgrade upon which concrete is placed shall be firm and free from water. Ground water shall be kept several inches below subgrade until concrete has set. When subgrade is in dry earth, it shall be moistened with water from a spray nozzle immediately before concrete is placed. Concrete that is to rest on rock shall not be placed until rock is fully uncovered and surface rock is removed to expose sound rock. Bedrock shall be roughly leveled off or cut to approximately horizontal and vertical steps. Seams in the rock shall be grouted as directed by the Engineer. The base of structures shall be slush grouted as directed by the Engineer.

Concrete that requires filter or drain material as a subgrade shall not be placed until the filter or drain material is placed and de-watered. De-watering shall continue to the extent necessary to prevent any portion of the concrete from being carried away before the concrete has attained its final set. Placing the reinforcement and pouring of concrete shall follow placing and de-watering the filter or drain material as closely as practical.

401.5.2 CONCRETE PLACEMENT

Concrete shall be delivered only in quantities required for placement within the specified time interval. Concrete having reached initial set prior to placement shall be discarded. No remixing with water or supplementing with other materials will be permitted once initial set has occurred.

Concrete shall be placed as nearly as possible to the final position to avoid segregation of the materials or displacement of the reinforcement.

Concrete shall be placed through steel or steel lined open troughs, chutes, or pipes. Troughs, chutes and pipes shall be clean and free from coatings or hardened concrete.

Concrete shall not be dropped a distance of more than 5 feet, unless approved in writing by the Engineer. Care shall be taken in placing concrete through reinforcement so that no segregation of course aggregate occurs. Splashing forms or reinforcement with concrete should be prevented. All hardened or partially hardened concrete on the forms or reinforcement above the level of previously placed concrete shall be removed before proceeding with work.

Placement of concrete in monolithic structures shall follow the sequence shown on the Plans for as approved by the Engineer.

Concrete deposited in horizontal layers shall not exceed 36 inches depth within a single placement. Concrete shall be placed at a rate so that: (1) no concrete surface shall attain initial set before additional concrete is placed on it; and (2) yielding of forms is not so great as to cause the concrete surface to exceed the specified tolerances.

All slabs and floors shall be placed to the finish elevation in one continuous operation. Except, the Contractor may place a separate finish topping if prior approval is received from the Engineer. The structural slab thickness shall be increased by the thickness of the separate finish topping. The finished floor elevation shown on the Plans shall be maintained.

401.5.2.1 COLD WEATHER PLACEMENT

Concrete shall be placed only when the temperature is at least 40°F. and rising, unless approved by the Engineer.

Slat, chemicals or other material shall not be mixed with the concrete for the purpose of preventing freezing. Accelerating agents may be used with written permission of the Engineer.

401.5.2.2 HOT WEATHER PLACEMENT

The temperature of fresh concrete at the time of placement during hot weather shall be a maximum of

90°F. to prevent accelerated setting of the concrete.

401.5.2.3 CONCRETE PLACED AGAINST EARTH

Earth cuts shall not be used as forms for vertical surfaces without prior approval of the Engineer or as shown on the Plans.

Concrete placed on or against earth shall be placed only upon or against firm, damp surfaces. Surfaces that are free from frost, ice, standing or running water. Concrete shall not be placed on mud or upon fill until the required compaction has been attained.

Slabs shall not be placed on dry porous earth. Polyethylene membrane may be laid over surfaces to receive the concrete, provided the Engineer approves. If the Engineer approves, the membrane shall be a 0.004 inch thick clear polyethylene sheeting or polyethylene-coated waterproof paper of the type specified for curing concrete. Tears in membrane material shall be repaired.

401.5.2.4 DEPOSITING CONCRETE IN WATER

Concrete may be deposited in water provided the methods and equipment are specifically authorized by the Engineer.

The tremie method is one method that may be approved. The tremie shall be watertight and sufficiently large to permit a free flow of concrete. The discharge end shall be kept submerged continuously in concrete and the shaft kept full of concrete to a point above the water surface. Placing of concrete shall proceed without interruption until the top of the concrete has been raised to the required elevation.

401.5.3 All concrete shall be consolidated immediately after placing with high frequency internal vibrators. External vibrators shall be used where concrete is inaccessible for internal vibrators. Forms shall be constructed sufficiently rigid to resist displacement or damage for external vibration is used.

Consolidation shall be accomplished by penetrating the concrete with the vibrator immediately after it is placed. The vibrator shall be moved throughout the mass so as to thoroughly work the concrete around reinforcement and embedded fixtures and into corners and form recesses. Vibrate the minimum time required to consolidate the concrete in place and not cause separation of the materials. Concrete shall be consolidated to the density required by the Concrete Mix Design. The vibrator size shall be selected to efficiently accommodate reinforcement clearances.

401.5.4 FINISHING

Concrete surfaces shall receive the class of finish shown on the Plans. The various classes of finish are described as follows:

(A) Class 1, Ordinary Surface Finish. Immediately following the removal of the forms, all fins and irregular projections shall be removed from all surfaces except from those which are not to be exposed or are not to be waterproofed. On all surfaces, the cavities produced by form ties, honeycomb spots, broken corners or edges and other defects shall be thoroughly cleaned, moistened with water and carefully pointed and trued with a mortar consisting of cement and fine aggregate and the surface left sound, smooth, even and uniform in color. Mortar patches shall be cured as specified in Section 401.5.6 or other approved methods.

All construction and expansion joints in the completed work shall be left carefully tooled and free of all mortar and concrete. The joint filler shall be left exposed for its full length with clean and true edges.

(B) Class 2, Rubbed Finish. After removal of forms, the rubbing of concrete shall be started as soon as its condition will permit. Immediately before starting this work, the concrete shall be kept moistened with water. Sufficient time shall have elapsed before the wetting down to allow the mortar used in the pointing to thoroughly set. Surfaces to be finished shall be rubbed with a medium coarse carborundum stone, using a small

amount of mortar on its face. The mortar shall be composed of cement and fine sand mixed in the same proportions as the concrete being finished. Rubbing shall be continued until all form marks, projections and irregularities have been removed, all voids filled and a uniform surface has been obtained. The paste produced by this rubbing shall be left in place.

After all concrete above the surface being treated has been cast, the final finish shall be obtained by rubbing with a fine carborundum stone and water. This rubbing shall be continued until the entire surface is of a smooth texture and uniform color.

After the final rubbing is completed and the surface has dried, it shall be rubbed with burlap to remove loose powder and shall be left free from all unsound patches, paste, powder and objectionable marks.

(C) Class 3, Float Finish. This finish, for horizontal surfaces, shall be achieved by placing an excess of material in the form and removing or striking off the excess with a template, forcing the coarse aggregate below the mortar surface. Creation of concave surfaces shall be avoided. After the concrete has been struck off, the surface shall be thoroughly worked and floated with a suitable floating tool. Before the finish has set, the surface cement film shall be removed with a fine brush in order to have a fine grained, smooth, but sanded texture.

(D) Class 4, Sand Blasted Finish. The cured concrete surface shall be sand blasted with hard, sharp sand to produce an even fine-grained uniform surface in which the mortar has been cut away. An exposed aggregate finish will not be required. However, aggregate exposed incidental to achieving the specified surface will be acceptable.

For colored concrete, the joints in the forms shall be sealed by an approved method.

(E) Class 5, Masonry Coating Finish. In lieu of Class 2 Surface Finish, the specified surfaces may be coated with a pearl gray cement base concrete coating as specified herein:

Materials: Masonry coating shall be a hydraulic cement base coating designed for use on porous surfaces of concrete and a decorative, protective and water repellent coating. The powder shall consist of a heavy cement base coating packaged in a dry form and shall conform to Federal Specification TT-P-21, Type I, Class B. The liquid acrylic shall be a combination of polymers and modifiers designed for use with Portland Cement, shall be fully compatible with water and shall be a product of the manufacturer of the cement base powder. All materials shall be delivered to the project site in sealed containers bearing the manufacturer's original labels. Cement base and liquid acrylic shall be mixed according to the manufacturer's recommendations.

Preparation of Surface: Surfaces shall be thoroughly cleaned by approved methods, free of dirt, projections, loose mortar particles and laitance.

Mixing: One part by volume of liquid acrylic to three parts by volume of water shall be mixed in a clean container. The dry powder shall be added to the liquid mixture and stirred until the resulting mixture attains the consistency of a batter mix. If the components are handmixed, the mixture shall set for 15 minutes, additional liquid shall be added, and the mixture shall be restirred to the batter consistency. The Contractor shall not use mixed quantities that cannot be applied within time limits specified by the manufacturer.

Application: The masonry Coating shall be applied in two coats using a tampico fiber brush. The first coat shall be applied at the rate of approximately 2 pounds per square yard of surface area. The second coat shall be applied the day following the first application before material has become too hard or glazed for good bond.

Surfaces to be coated shall be dampened immediately ahead of the application. The masonry coating shall not be applied as a thin coat, but shall be laid on the surface and leveled out. If the wall becomes dry or the coating starts to pull during application, the wall shall be dampened again. The mixture shall not be thinned. The mixture shall not be

applied on frost-covered surfaces, frozen walls, when the temperature is below 40°F. or when temperatures are predicted to fall below 40°F. within 24 hours. If the surfaces have been exposed to hot sun conditions, they shall be cooled by hosing with clean water.

When the work is progressing under hot sun, drying wind or when evidence of extremely rapid drying appears, the finished surface shall be cured by fog spraying with water.

401.5.5 PROTECTION

The Contractor shall always have materials available to protect the surface of the plastic concrete against rain. These materials shall consist of waterproof paper, plastic sheeting or curing blankets. Concrete damaged by rain may be required to be removed and replaced at the Contractor's expense.

401.5.6 CURING

All finished surfaces, corners and edges shall be protected from stains, abrasions and breakage.

The Contractor shall maintain the concrete surface temperature above 50° during the curing period when the ambient temperature is below 35°F. The Contractor shall be responsible for determining the necessity for undertaking protective measures.

Irrespective of the temperature conditions at time of placement, means shall be provided for maintaining the concrete at a temperature of at least 50°F. for the first five (5) days. And, at a temperature above freezing for the remainder of the time required for the concrete to attain minimum design strength. However, this period may be reduced to 72hours, provided high-early strength cement is used.

The methods proposed for heating the materials and protecting the concrete shall be approved by the Engineer.

Immediately after placing fresh concrete, all concrete shall be cured by one of the following methods. The Engineer shall approve the curing method proposed by the Contractor:

WATER METHOD. All surfaces other than slabs shall be protected from the sun and the structure kept wet at least 5 days following concrete placement. Covering may be removed temporarily for finishing surfaces requiring a Class 2 finish, but the covering must be restored as soon as finishing is completed.

All concrete slabs shall be covered with suitable material immediately following placement so that concrete is kept thoroughly wet for a least 5 days. The concrete surface shall be kept moist at all times by fogging with an atomizing nozzle until the covering is placed.

MEMBRANE FORMING CURING COMPOUND METHOD. Curing compound may be applied only to those surfaces which are to receive a Class 1 or Class 4 finish, unless compound used is harmless to joints or surfaces to be worked.

Curing compound shall be applied at the manufacturer's recommended coverage, unless otherwise directed by the Engineer. All concrete cured by this method shall receive two applications of curing compound. This first coat shall be applied just as the surface film of water disappears. The second application shall be applied after the first application has set. During curing operations, any unsprayed surfaces shall be kept wet with water.

The coating shall be protected against marring for at least 10 days after application. Any marred coating shall be given an additional coating. Should the surface coating be subjected to continuous injury, water curing shall be applied at once.

The curing compound shall be thoroughly mixed according to the manufacturer's instructions, but not more than one hour prior to use.

Use of curing compound shall be discontinued if its use results in a streaked or blotchy appearance.

Water curing shall be applied until the cause of the defective appearance is corrected.

FORM METHOD. Concrete shall be protected by forms for at least 5 days. Forms shall be kept moist, when necessary, during the curing period to insure the concrete surface remains wet.

BLANKET METHOD. Insulation blankets may be used in cold weather to maintain the required curing temperature and to retain moisture in the concrete. Blankets shall be free of holes and edges lapped at least 8 inches. Blankets shall be secured at laps and edges to prevent moisture from escaping.

401.6 QUALITY CONTROL

401.6.1 DELIVERY, STORAGE AND HANDLING OF MATERIALS

Cement shall be stored in weather-tight enclosures and protected against dampness, contamination or storage set.

Aggregates shall be stockpiled in a manner that shall minimize excessive segregation, contamination or mixing with other sizes of aggregates.

Admixtures shall be stored to prevent exposure to harmful temperature ranges, evaporation, contamination and damage. All admixtures shall be agitated in accordance with the manufacturer's recommendations prior to use.

401.6.2 TESTING

Concrete testing and testing laboratory services required shall be provided by the Contractor through an Engineer approved testing laboratory. Testing shall meet the requirements of ACI 301, Chapter 16 - TESTING.

401.6.3 ACCEPTANCE OF CONCRETE

Field strength level of concrete shall be considered acceptable, provided the average test strength of 3 cylinders is not less than 80% of the specified laboratory design 28 day strength. And further

provided, that no single test cylinder result falls more than 500 psi below the 80% level.

All placed concrete failing to meet the specified strength requirements, density or surface requirements, or which may have frozen, shall be subject to corrective action as determined by the Engineer.

401.6.4 REPAIRING CONCRETE

Concrete surfaces shall be inspected for defects immediately after form removal. Repair of defects shall be completed within 48 hours after form removal. Defects shall be inspected by the Engineer and the Engineer shall approve repair methods prior to repairs being undertaken.

All damaged and defective concrete shall be removed from the area to be repaired. Honeycombed, sand streaked and fractured concrete shall be considered defective. Repair areas shall be chipped to a depth of one inch. Edges of repair areas shall be squared to the surface to eliminate feather edges.

The repair area shall be clean, free of chipping dust, dried mortar and foreign material. Surfaces to be repaired shall be wet continuously for a least three hours prior to placing repair concrete or mortar. Repair surface shall not show free water at time repair materials is replaced.

The Engineer shall inspect repair area immediately prior to placement of repair materials.

401.7 CLEAN UP

The exposed surfaces of the concrete shall be thoroughly cleaned upon completion of the work and the site left in a neat and orderly condition.

410 CONCRETE FRAMEWORK

410.1 SCOPE

All formwork for cast-in-place concrete structures shall conform to the requirements specified herein. Furnishing all materials and labor for placement and removal of formwork are included.

Bridge deck forms and falsework are excluded from this Specification.

419.2 QUALITY STANDARDS

The latest published revision of the Quality Standards in effect at time of bid shall apply.

ACI 347 Recommended Practice for Concrete Formwork

410.3 SUBMITTALS

The Contractor shall submit a description of the forming system with complete details. The location of all construction joints shall be detailed. The methods proposed for securing embedded items and blockout procedures shall also be defined.

410.4 MATERIALS

Form lumber for all exposed concrete surfaces shall be dressed at least on one side and two edges and shall be constructed to produce mortar-tight joints and smooth, even concrete surfaces. Forms shall be filleted and chambered and shown on the Plans. Forms shall be given a bevel or draft to assure easy removal from all projections.

Plywood shall be "B-B Plyform Class 1 Exterior" grade plywood, 5/8 inch minimum thickness in new or near new condition.

Metal forms shall be of sufficient thickness or braced to resist noticeable deflection from pressure of the concrete. All bolt and rivet head shall be countersunk. Clamps, pins or other connecting devices shall hold the forms rigid during curing and allow removal without injury to the concrete. Metal forms which do not provide a smooth surface or do not align properly shall not be used. Metal forms shall be free from rust, grease or other foreign matter.

Framing, studding, and bracing shall be accomplished by use of standard or construction grade lumber, according to ACI 437.

Metal ties or anchorages within the forms shall be designed to permit their removal to a depth of at least $\frac{1}{2}$ inch from the face without injury to the concrete. Form ties shall be designed to resist the loads imposed by freshly poured concrete and permit tightening spreading of forms. Twisted wire loop ties and wooden spreaders shall not be used.

Non-staining form oil that will not impair the finished concrete surface may be used as a form coating. Lacquer, plastic or epoxy coated forms may be used in lieu of a liquid form coating. Form coatings containing mineral oils or non-drying ingredients shall not be used.

Standard patented and manufactured shores or sound construction grade lumber may be used for shores and falsework.

Chamfer strips shall be $\frac{3}{4}$ inch 45° bevel wood strips or reusable triangular plastic strips.

410.5 EXECUTION OF WORK

410.5.1 DESIGN OF FORMWORK

Formwork shall be designed to safely support the vertical and lateral loads applied until the loads can be supported by the concrete structure. Vertical and lateral loads shall be transferred by the formwork system to the ground or to adequately cured in-place construction.

Forms and falsework shall be designed to include live load, dead load, moving equipment and operating on formwork, concrete height of concrete drop, vibrator frequency, ambient temperature, foundation pressures, stresses, lateral stability and other factors pertinent to safety of personnel and the structure during construction.

Shores and struts used shall be provided with means of positive adjustment capable of compensating for formwork settlement during placement operations. Wedges, jacks or a combination of both shall be used. Trussed supports shall be provided when adequate foundation for shores and struts does not exist.

Form facing materials shall be supported by structural members spaced to minimize deflection. Camber shall be designed into the formwork to compensate for anticipated deflections.

Formwork shall be designed to be readily removed without impact, shock or damage to concrete surfaces or adjacent material.

410.5.2 CONSTRUCTION OF FORMS

Forms for exposed concrete shall be constructed of plywood, metal forms, or other material specifically approved by the Engineer. Forms shall provide a smooth and continuous forming surface.

Forms for unexposed concrete may be identical to those used for exposed concrete. One inch construction grade shiplapped or tongue-and-groove lumber may also be used.

Form ties shall be tight fitting to prevent mortar leakage at holes in the forms. Ties shall be protected from rusting at all times. Form ties shall be installed at all vertical and horizontal construction joints to provide tight joints.

Lines, levels, and elevations shall be checked for accuracy and all inaccuracies corrected. Vertical and horizontal form position shall also be verified and corrected. All wedging and bracing shall be completed prior to concrete placement.

All dirt, chips, sawdust, mud, water and other foreign matter shall be removed from within the forms and excavated areas before concrete is deposited therein.

Pipes, castings, conduits, or inserted and embedded items shall be placed in the forms before pouring concrete. Cored opening or blockouts may be placed in the forms when specifically approved by the Engineer. Cores or blockout boxes shall be provided with continuous keyways or waterstops around the periphery and tapered slightly to facilitate grouting. All inserted and embedded items shall be supported to ensure accurate alignment and minimize distortion during concrete placement.

410.5.3 INSPECTION

The Engineer shall inspect the forms after reinforcing steel is placed and prior to concrete placement. The Engineer shall be notified at least 24 hours prior to scheduled concrete placement.

410.5.4 FORM REMOVAL

Supports shall not be removed until the concrete has attained at least 80% of the specified 28 day strength or as specifically approved by the Engineer.

The forms for any portion of the structure shall not be removed until the concrete is strong enough to withstand damage when the forms are removed.

Side forms for cast-in-place beams, walls or other member where the forms do not resist dead load bending shall remain in place for at least 12 hours after concrete placement, exclusive of periods when ambient temperature is below 40° F.

Forms may be removed earlier than defined above, provided high-early strength concrete is used. Removal time shall be as specifically approved by the Engineer.

All forms shall be removed except as provided on the Plans.

Form removal methods shall not cause over stressing. Supports shall be removed in a sequence that permits the concrete to gradually and uniformly absorb its weight stress. Supports and forms shall not be removed by high impact methods. Ties shall be broken after concrete has cured sufficiently to maintain unbroken bond with tie rod.

410.5.5 REUSE OF FORMS

Used forms intended for use for exposed concrete shall be reconditioned to "like new" condition. All reused forms shall be cleaned, repaired and recoated before each reuse.

410.6 QUALITY CONTROL

Form movement or deflection during concrete placement that results in finished surface variations in excess of the tolerances specified may be the basis for rejection and replacement of cast-in-place concrete.

410.7 CLEAN UP

Forms, shores, struts, bracing, lumber and all trash shall be removed from the site upon completion of the work, and the site left in a neat and orderly condition.

420 CONCRETE REINFORCEMENT

All reinforcement for cast-in-place concrete structures shall conform to the requirements specified herein. Furnishing all materials and labor for placement are included.

420.2 QUALITY STANDARDS

The latest published revision of the Quality Standards in effect at time of bid shall apply.

AASHTO M 36: Deformed and Plain Billet - Steel Bars for Concrete Reinforcement

AASHTO M 53: Axle- Steel Deformed and Plain Bars for Concrete Reinforcement
AASHTO 55: Welded Steel Wire Fabric for Concrete Reinforcement

ACI 315: Manual of Practice for Detailing Reinforced Concrete Structures

ASTM A 185: Welded Steel Wire Fabric for Concrete Reinforcement

ASTM A 615: Billeted Steel Bars for Concrete Reinforcement

CRSI: Manual of Standard Practice, Concrete Reinforcing Steel Institute

420.3 SUBMITTALS

The Contractor shall submit bending and cutsheet schedules and drawings defining placing of reinforcing steel.

420.4 MATERIALS

All materials, manufacturing operations, testing and inspection of Concrete Reinforcement shall conform to the requirements of the applicable Quality Standards listed in Section 420.2.

Reinforcing bars shall be deformed steel bars of the size and grade detailed on the Plans.

Welded wire fabric shall be of the gauge and mesh specified on the Plans.

Tie wire shall be 16 gauge black annealed steel wire, except when epoxy coated reinforcing is used.

Reinforcing bar supports shall conform to Chapter 3 of CRSI Manual and shall be galvanized or plastic coated, where legs will be exposed in finished concrete surfaces. Otherwise, concrete bricks or mortar blocks may be used.

Reinforcement materials shall be delivered in bundles marked or identified to coordinate with the placement drawings. Materials shall be handled and stored to prevent contamination from dirt, oil and other materials that could affect bonding capacity with the concrete. Materials should be stored off ground in locations where the material shall not be subject to abuse or damage.

420.6 QUALITY CONTROL

Dirt, grease, oil, loose mill scale, excessive rust and foreign matter that may interfere with concrete bond shall be removed prior to placement.

Minimum concrete cover over the reinforcement detailed on the Plans shall be maintained throughout the construction.

420.7 CLEAN UP

The stockpile shall be left in a neat and orderly condition upon completion of the work.

440 JOINTS IN CAST-IN-PLACE CONCRETE

440.1 SCOPE

All construction joints, expansion and contraction joints, and water-tight joints in cast-in-place concrete shall conform to the requirements specified herein. Furnishing all materials and labor for placement are included.

440.2 QUALITY STANDARDS

The latest published revision of the Quality Standards in effect at the time of bid shall apply.

AASHTO M 33: Preformed Expansion Joint Filler for Concrete (Bituminous Type)

AASHTO M 153: Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

AASHTO M 173: Concrete Joint Sealer, Hot Elastic Type

AASHTO M 213: Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction.

440.3 SUBMITTALS

The Contractor shall submit a list of joint material to be used along with the names of the manufacturers and local suppliers.

The Contractor shall submit shop drawings detailing waterstop slice (weld) locations, intersection details, and support and forming details. Specifications and descriptive literature for the splice welding tools shall also be submitted along with the qualifications of the splice welder.

The Contractor shall submit drawings detailing all construction joints that are not shown on the Plans.

440.4 MATERIALS

Joint bonding materials required for construction joints shall be as shown on the Plans or defined in the Special Provisions.

Joint sealer, preformed joint filler and joint waterstop materials shall conform to the requirements of the applicable Quality Standards listed in Paragraph 440.2.

Closed cell polyethylene backer-rod shall be used in sealant joints. The back-rod shall be resilient and approved by the sealant manufacturer. Backer-rod diameter shall be 1/8 inch larger than width of groove.

440.5 EXECUTION OF THE WORK

440.5.1 CONSTRUCTION JOINTS

Construction joints shall be located only as shown on the Plans or as approved by the Engineer prior to each pour. All construction joints shall be keyed, unless shown otherwise on the Plans.

Reinforcement shall be continued through the joint, unless shown otherwise on the Plans.

Bulkheads shall be constructed to make waterstops and reinforcement to prevent concrete leakage.

Previously placed concrete shall be thoroughly roughened and air cleaned prior to placement of additional concrete. Place concrete continuously to a predetermined construction joint or level.

440.5.2 EXPANSION AND CONTRACTION JOINTS

Joints shall be constructed in accordance with and at the locations shown on the Plans. Reinforcement shall not extend through joint, unless specifically shown on the Plans.

Preformed fillers shall be secured with fasteners and procedures recommended by the manufacturer.

Sealant surfaces shall be clean and free of oil, grease, residue and other foreign materials prior to application of primer or sealant. All joints shall be primed with a joint primer recommended by the sealant manufacturer.

Surfaces adjacent to joints shall be protected from sealant application. Backer-rod shall be accurately placed in the joint groove to provide the depth of sealant without intermediate stops and starts, and avoiding air entrapment.

Sealants shall be applied according to the manufacturer's recommendations.

Joints shall not be exposed to a hydrostatic pressure, until sealant has cured for at least 7 days.

440.5.3 WATERTIGHT JOINTS

Waterstops shall be provided for and installed in all locations shown on the Plans. Reinforcement shall not extend through joint, unless specifically shown on the Plans.

Splices and intersections shall be made in accordance with the submittals.

Waterstops shall be installed in accordance with the manufacturer's installation instructions for continuous watertightness. The concrete shall be thoroughly vibrated or consolidated under and around the waterstop to achieve concrete contact with all waterstop surfaces. Hand placement of concrete may be required.

Waterstops shall be placed in the forms in a manner that will prevent deformation, distortion or displacement during concrete placement. Waterstop support during concrete placement shall conform to the manufacturer's published recommendations or to Engineer-approved submittal.

440.6 QUALITY CONTROL

The manufacturer shall furnish certification that all of the inspections and tests have been made and

the results thereof comply with the requirements of the applicable standards specified in Section 440.2.

The Contractor shall furnish the Engineer two copies of the manufacturer's certificates.

440.7

CLEAN UP

Clean up required shall conform to the requirement of Section 401.



SECTION 500

SPECIFICATIONS FOR CONSTRUCTION

REINFORCED CONCRETE UNIT MASONRY CONSTRUCTION

500.0 GENERAL: This section shall cover furnishing materials, mixing, transporting, placing, finishing, curing, reinforcement, anchorage, and accessories associated with the construction of reinforced concrete unit structures.

501.0 PERMITS: Permits shall be obtained before work begins. Contractor shall call for inspection, giving 24 hours notice.

502.0 QUALITY STANDARDS:

The following materials and workmanship standards shall apply to all work on Concrete Unit Masonry structures.

ASTM C90 Grade N Concrete Masonry Units

ASTM C270 Type M: Mortar

ASTM C476: Grout

ASTM A615: Reinforcing Bars

503.0 SUBMITTALS: The contractor shall submit the following:

(1) Certification of quality of all masonry units, mortar and grout

(2) Certification of quality of all curing materials and admixtures, if applicable, with proposed methods of use.

504.0 MATERIALS: The materials used shall meet the requirements of one or more of the Quality Standards listed above.

(1) Hollow concrete masonry units: Blocks shall have cores of 4" x 4" dimension min.

(2) Reinforcing Bars: Conforming to the requirement of Section 420.4 of the City of Durango Public Works Department Standard Specifications.

(3) Single Width Joint Reinforcement: Truss type, plain steel conformation, 9 ga. as manufactured by Duro-Wall or equivalent.

(4) Wall Ties - Duro Wall D/A 207 or equivalent.

- (5) Mortar - made w/ASTM C144 standard masonry aggregate, ASTM C150 normal Type 1 Portland cement, tinted to match block color.
- (6) Grout - made w/aggregate of maximum size of 3/8" 25% by volume; grout should be plastic; able to be pumped without separation of materials.
- (7) Admixtures - hydrated lime conforming to ASTM C207 type S may be added to Portland cement in the ratio of 1 part Portland cement to 1/4 part hydrated lime by volume. If plastic cement is used, the ratio of hydrated lime may only be 1/10. Plasticizers shall be of water reducing type which reduces absorption and porosity. Coloring shall be only of pure mineral oxide, carbon black, or synthetic color. Carbon black shall be limited to a maximum of 3% by weight of the cement.

505.0

MIXING:

1. Mortar shall be mixed thoroughly in quantities for immediate use.
2. Grout shall be mixed thoroughly and used within a period of 90 minutes after the cement comes in contact with the mixing water.

506.0

EXECUTION OF WORK:

The contractor shall perform work in the following manner:

1. Clean support surface of first course free of mud, loose aggregate, grease, or any foreign matter which will prevent a bond with first course of masonry units.
2. Clean reinforcement free from rust, scale, earth or other foreign matter.
3. Locate reinforcement at spacing shown on plans. Secure reinforcement against displacement. Horizontal reinforcement may be set as work progresses. All laps must be 12" minimum and be welded or wire tied.
4. Place masonry units with full head and bed joints. Surfaces to be in contact with mortar shall be clean and free of deleterious materials. The mortar shall be sufficiently plastic and units shall be placed with sufficient pressure to extrude mortar from the joint and to produce a tight joint. Maintain joint thickness of 3/8".
5. Embed "Durowall" in joints as work progresses, with minimum mortar cover of 5/8".

6. Lay masonry units in "center bond" so vertical joints in any given course aligns with the center of units above and below.
7. Maintain continuous vertical core shaft for grouting. The minimum clear distance between reinforcement metal and the masonry surface shall be 1/2 ".
8. As work progresses, build in metal frames and anchoring appurtenances. Build in frames plumb and level. Fill frame voids solid with mortar.
9. Finish joints by striking to concave finish, after mortar has partially set but still will compact and bond. Tools used should press excess mortar out of joint, not drag it out.
10. Do not place grout until the entire height of masonry wall has become strong enough to resist displacement or breaking of mortar bonds. Grout lifts of more than 12 inches shall be consolidated with a mechanical vibrator.
11. Weather conditions - all masonry materials shall be kept at a temperature below 90 degrees F. Masonry materials shall also be protected from rain and a freshly laid wall shall be protected from rain for 24 hours.

507.0

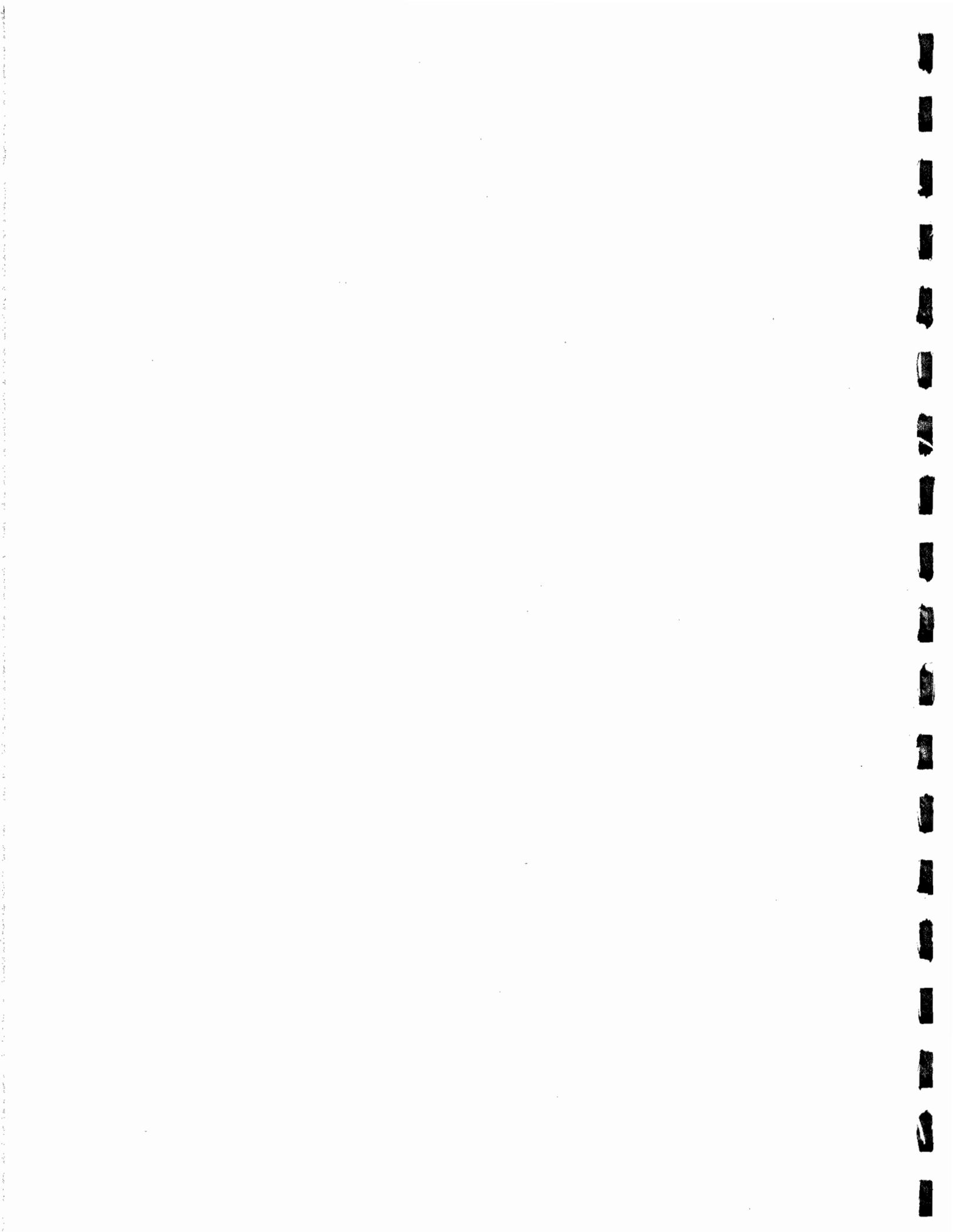
QUALITY CONTROL:

1. All cement, aggregates, and admixtures shall be delivered, stored and handled as per Section 401.6.1 of the Standards Specifications.
2. Masonry materials shall be stored so that at the time of use the materials are clean and structurally suitable for the intended use. Masonry units shall not be wetted unless otherwise approved.

508.0

CLEAN UP:

- The exposed surfaces of the masonry shall be thoroughly cleaned upon completion of the work and the site left in a neat and orderly condition.



SECTION 600

STANDARD SPECIFICATIONS FOR STRUCTURAL METAL

600.0 GENERAL: This section shall cover all materials and work pertaining to the erection of structural steel members.

601.0 Quality Standards

ASTM A36: Structural Steel

602.0 SUBMITTALS: The contractor shall submit the following:

Certification of quality of all steel materials and welding supplies

603.0 MATERIALS:

The materials used shall meet the requirement stated in Section 601.0 above.

The shade, dimensions and thickness of steel members shall be supplied as shown on the plans.

Filler metal and flux for welding shall be in conformance with specifications of the American Welding Society, where appropriate.

604.0 EXECUTION OF WORK:

Steel shall be straight and true, plumb and level at time of installation. Bracing and framing required to set steel in concrete and masonry shall be rigid and solidly attached to steel until concrete is properly set.

The contractor shall weld permanent connections. Joints exposed to weather shall be formed to exclude water. Dress face of exposed welds.

The contractor shall prime and paint metal members so as to prevent rusting, protect moving parts, hinges, and locking bars from paint clogging, and mask adjacent materials from paint spray.

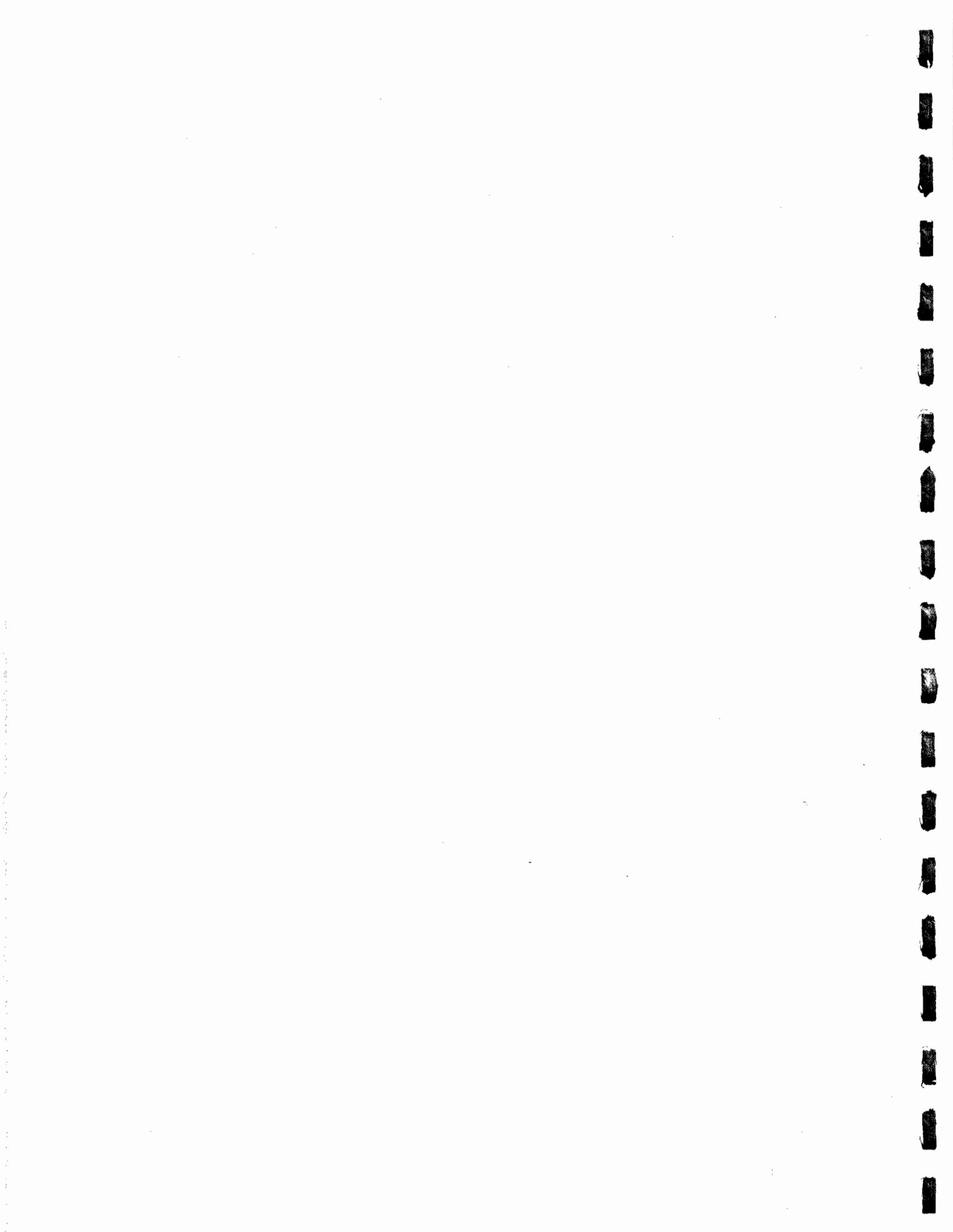


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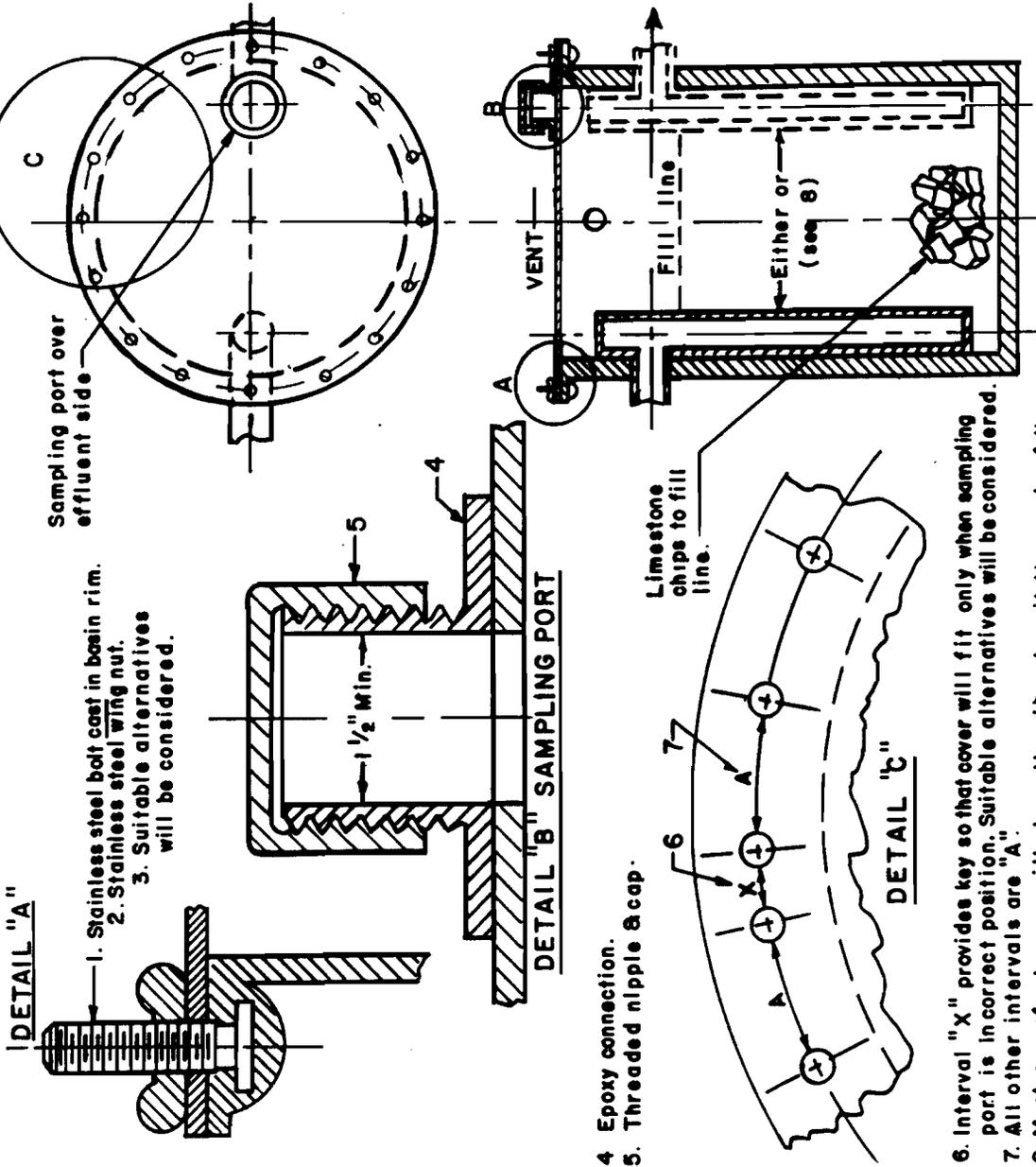
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ACID NEUTRALIZATION UNIT



11. Materials: (Specific materials must be selected for specific applications.)
- High density polyethylene & polypropylene materials are recommended in most cases.
 - Vitrified clay units are suitable in most cases.
 - Concrete units lined with "acid resistant" material will not be approved.
12. Acid neutralization tanks & installations thereof must be inspected & approved by the Wastewater Div.

Sampling port over effluent side

1. Stainless steel bolt cast in basin rim.
2. Stainless steel wing nut.
3. Suitable alternatives will be considered.

1 1/2" Min.

DETAIL "B" SAMPLING PORT

4. Epoxy connection.
5. Threaded nipple & cap.

Limestone chips to fill line.

DETAIL "C"

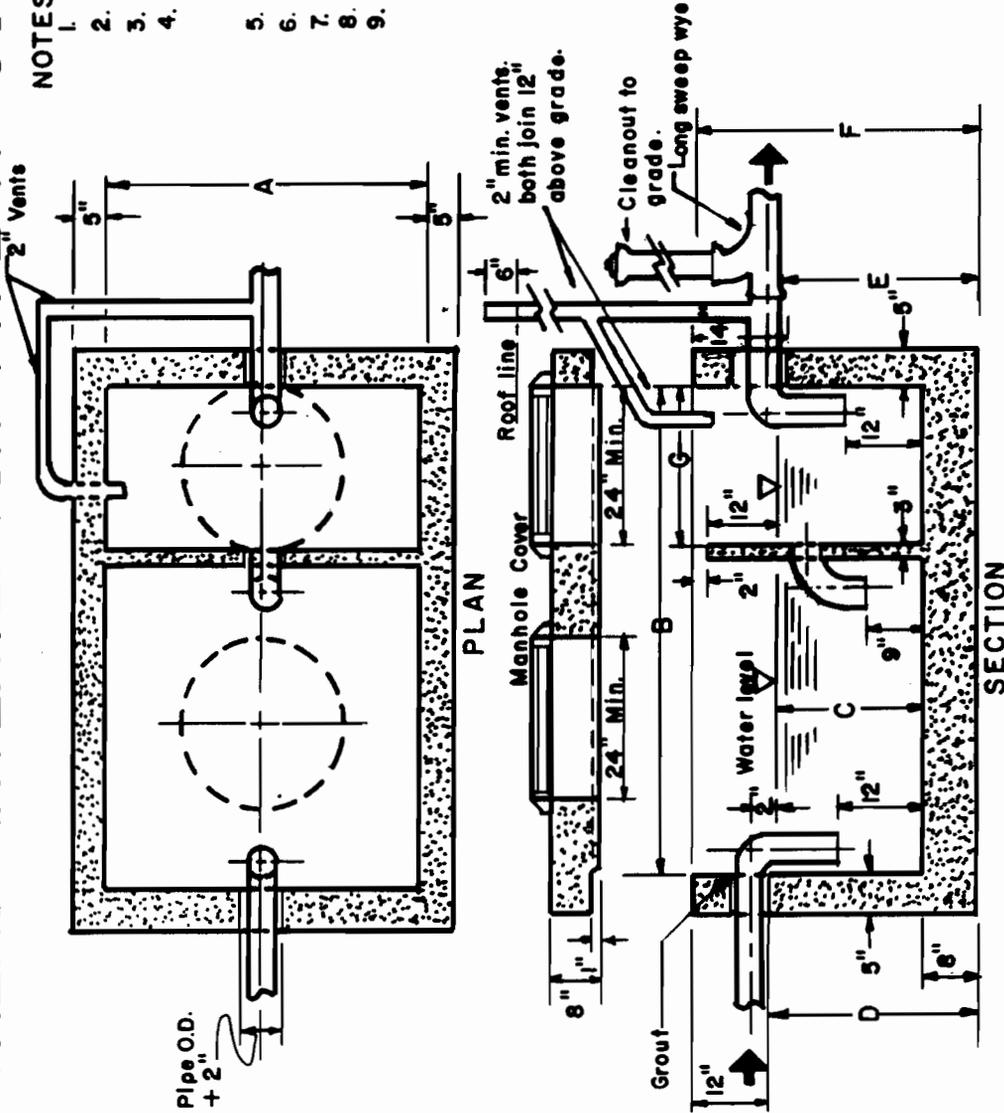
6. Interval "X" provides key so that cover will fit only when sampling port is in correct position. Suitable alternatives will be considered.
7. All other intervals are "A".
8. Most manufacturers will place the riser to suit the needs of the customer. The riser must be in one location or the other, not both.
9. All units must be installed so that they are easily accessible for maintenance & testing.
10. Where a unit is to be located underground, a concrete vault must be extended to a point no less than 6" and no more than 12" below the level of the finished floor or ground.

CITY OF DURANGO	
PUBLIC WORKS DEPARTMENT	
ENGINEERING DIVISION	
GENERAL SPECIFICATIONS	
DWN. BY	A. G. W.
DATE	12 - 14 - 82
APPV. BY	DWG. NO. S-1

GREASE INTERCEPTOR TYPE "A" COMMERCIAL

NOTES:

1. Secondary compartment has volume equal to 1/3 of total capacity.
2. All pipe & fittings to be cast iron, 3" dia. minimum.
3. Walls & bottom reinforced throughout with 2x16 6/10 rebar.
4. Covers to be reinforced longitudinally with no. 6 rebar on 6" centers, no. 4 rebar on 6" centers widthwise, & no. 8 rebar diagonally around access holes.
5. Cleanout shall be an iron body ferrule with brass screw plug.
6. Vent pipe shall be cast iron to a point 6" above ground level.
7. Manhole ring & cover shall be J-Mark 1161 or approved equal.
8. Check with SUPPLIER for EXACT DIMENSIONS.
9. NO BOLT DOWN COVERS ALLOWED without permission from the Wastewater Division.



	Water Capacity Approx. Gallons	Grease Capacity Approx. Cubic Feet	DIMENSIONS						
			TWO COMPARTMENT TANK INCHES						
			A	B	C	D	E	F	
UP TO 2000 SQ. FT.	320	17	48	72	22	32	30	44	24
UP TO 3000 SQ. FT.	500	32	48	72	36	46	44	58	24
UP TO 5000 SQ. FT.	780	47	48	96	40	48	48	62	20
UP TO 10000 SQ. FT. OVER	1060	74	72	102	34	42	42	54	20
10000 SQ. FT.	1260	87	80	112	35	43	41	57	20

CITY OF DURANGO
PUBLIC WORKS DEPARTMENT
ENGINEERING DIVISION
GENERAL SPECIFICATIONS

DWN. BY A.G.W.

DATE 12-14-82

APPV. BY

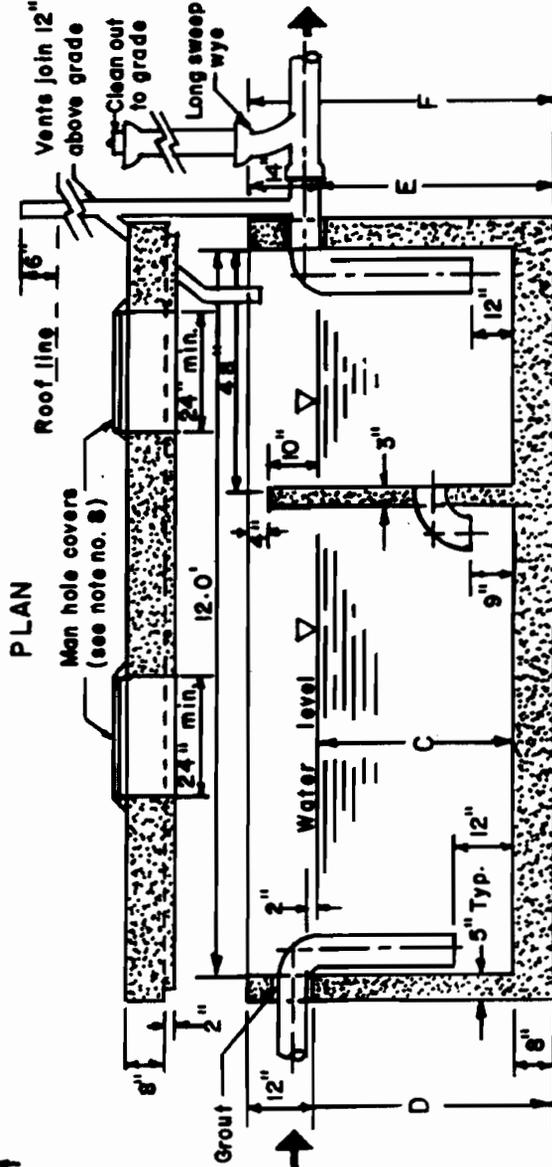
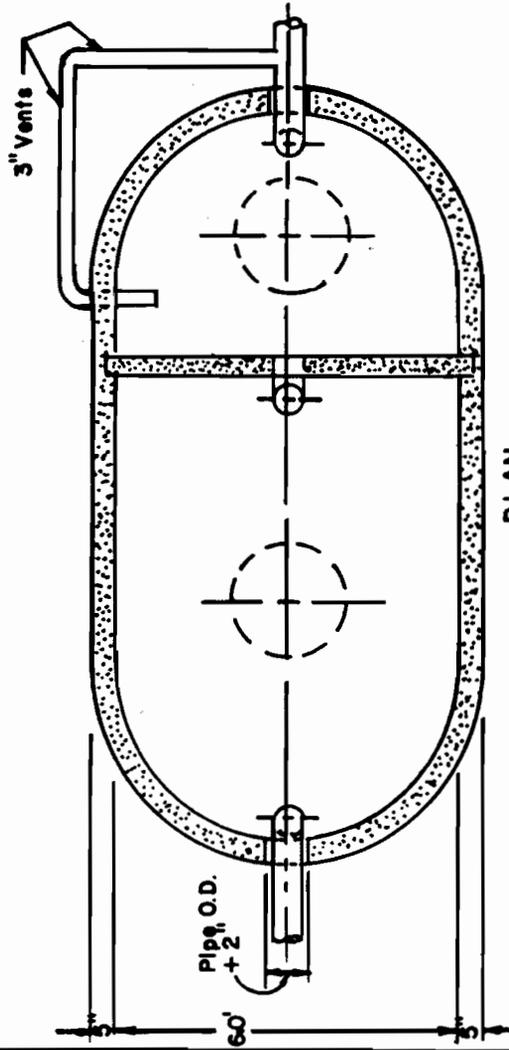
DWG. NO.

S-2

GREASE INTERCEPTOR TYPE "B" INDUSTRIAL

NOTES:

1. Secondary compartment has volume equal to 1/3 of total capacity.
2. All pipe & fittings to be cast iron, 3" dia. min.
3. Walls & bottom reinforced throughout with 2x16 #10 mesh.
4. Covers to be reinforced longitudinally with no. 6 rebar on 6" centers, no. 4 rebar on 6" centers widthwise, & no. 8 rebar diagonally around access holes.
5. Cleanout shall be an iron body ferrule with brass screw plug.
6. Vent pipes shall be cast iron to a point 6" above ground level.
7. Manhole ring & cover shall be J-Mark 1161 or approved equal.
8. NO BOLT DOWN COVERS ALLOWED without permission from the Durango Wastewater Dept.
9. CHECK with SUPPLIER for EXACT DIMENSIONS.
10. Grease capacity rated for large compartment only.



	Gross Capacity Cu Ft. (approx.)	Water Capacity Gallons (approx.)	Dimensions - inches		
			C	D	F
UP TO 5000	100	1855	40	90	48
" 10000 "	121	1900	48	98	54
" 15000 "	143	2038	52	92	50
" 25000 "	186	2509	64	74	72
" 35000 "	229	2978	78	88	84
" 50000 "	280	3210	82	92	90
OVER 50000	271	3445	88	98	96

CITY OF DURANGO
PUBLIC WORKS DEPARTMENT
ENGINEERING DIVISION
GENERAL SPECIFICATIONS

DWN. BY A. G. W.

DATE 12-16-82

APPV. BY

DWG. NO.

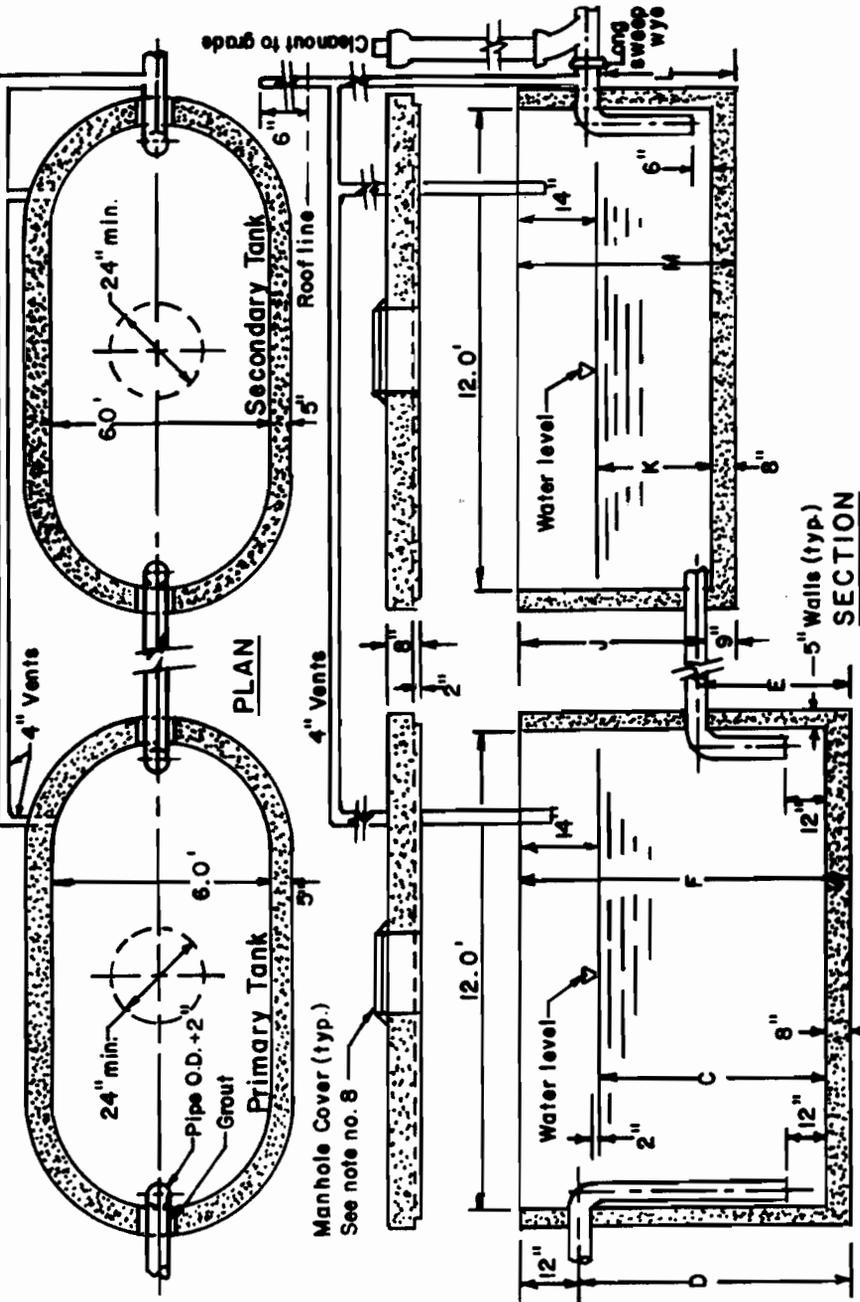
S-2

SHEET NO. 2 OF 3

GREASE INTERCEPTOR TYPE "C" INDUSTRIAL

NOTES:

1. Secondary tank has volume equal to 1/3 of the combined capacity,
2. All pipe & fittings to be cast iron, 3" dia. min.
3. Walls & bottom reinforced longitudinally with 2x16 6/10 mesh.
4. Covers to be reinforced longitudinally with no. 6 rebar on 6" centers, no. 4 rebar on 6" centers widthwise, and no. 8 rebar diagonally around access holes.
5. Cleanout shall be an iron body ferrule with brass screw plug.
6. Vent pipe shall be cast iron to a point 6" above ground.
7. Manhole ring & cover shall be "J-Mark" no. 1161 or approved equal.
8. NO BOLT DOWN COVERS ALLOWED without permission from Durango Wastewater Dept.
9. Vents join 1" min. above grade.
10. Grease capacity rated for large compartment.
11. CHECK with SUPPLIER for EXACT DIMENSIONS.



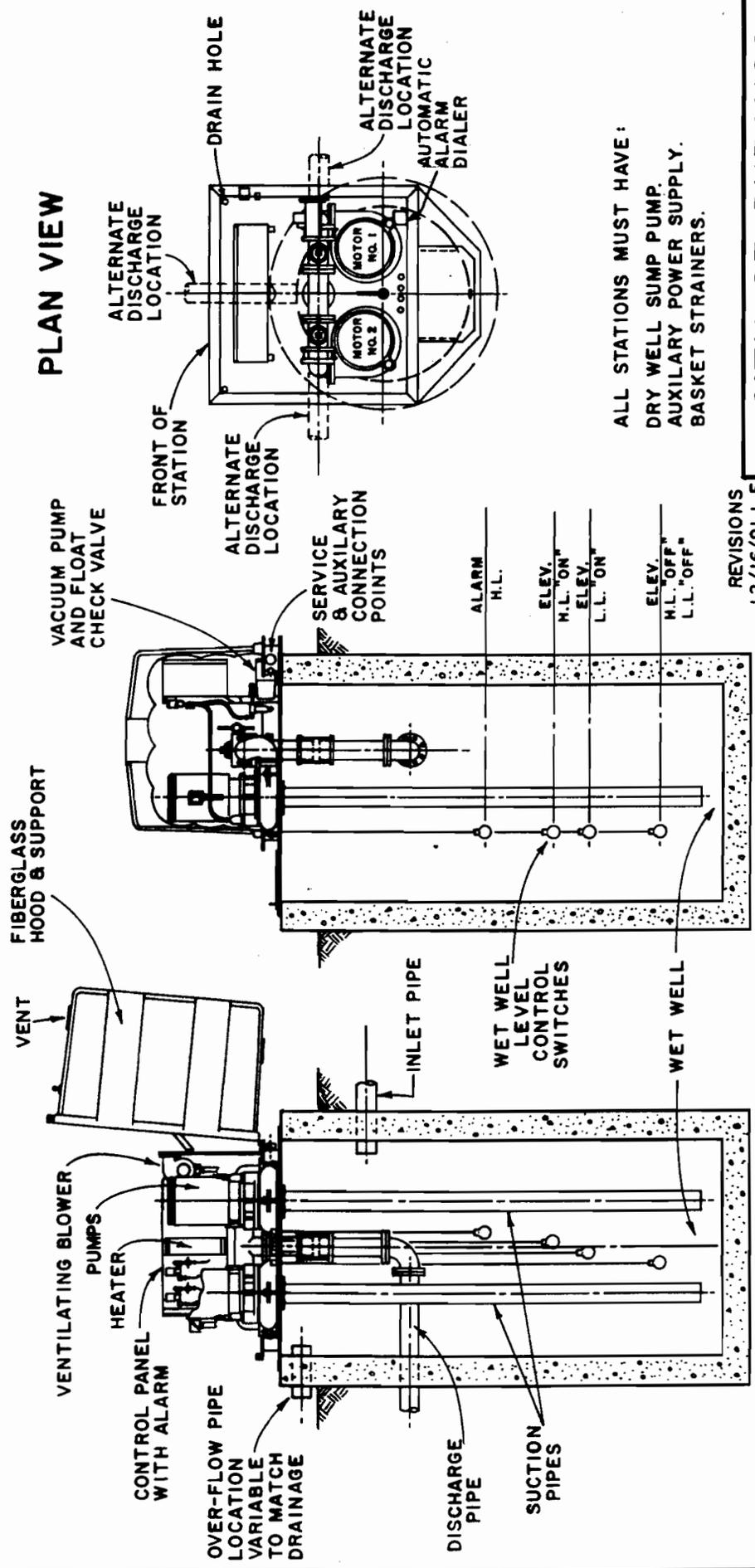
Water Capacity Gallons (Approx)	Grease Capacity Cu. Ft. (Approx)	DIMENSIONS												
		Primary					Secondary							
		C	D	E	F	G	H	I	J	K	L	M		
4160	311	70	80	45	32	47	34	42	56					
4640	343	76	96	45	98	53	40	48	62					
4880	375	82	92	51	104	53	40	48	62					
5360	407	88	98	51	110	59	46	54	68					
5600	439	94	104	57	116	59	46	54	68					
6060	471	100	110	57	122	65	52	60	74					

CITY OF DURANGO
PUBLIC WORKS DEPARTMENT
ENGINEERING DIVISION

GENERAL SPECIFICATIONS

DWN. BY: A.G.W. DATE: 12-17-82

APPV. BY: DWG. NO. S-2



ALL STATIONS MUST HAVE:
 DRY WELL SUMP PUMP.
 AUXILIARY POWER SUPPLY.
 BASKET STRAINERS.

REVISIONS
 12/16/91 L.F.

CITY OF DURANGO	
PUBLIC WORKS DEPARTMENT	
ENGINEERING DIVISION	
GENERAL SPECIFICATIONS	
DWN. BY	D.F.
DATE	11-30-83
APPV. BY	DWG. NO. S-3

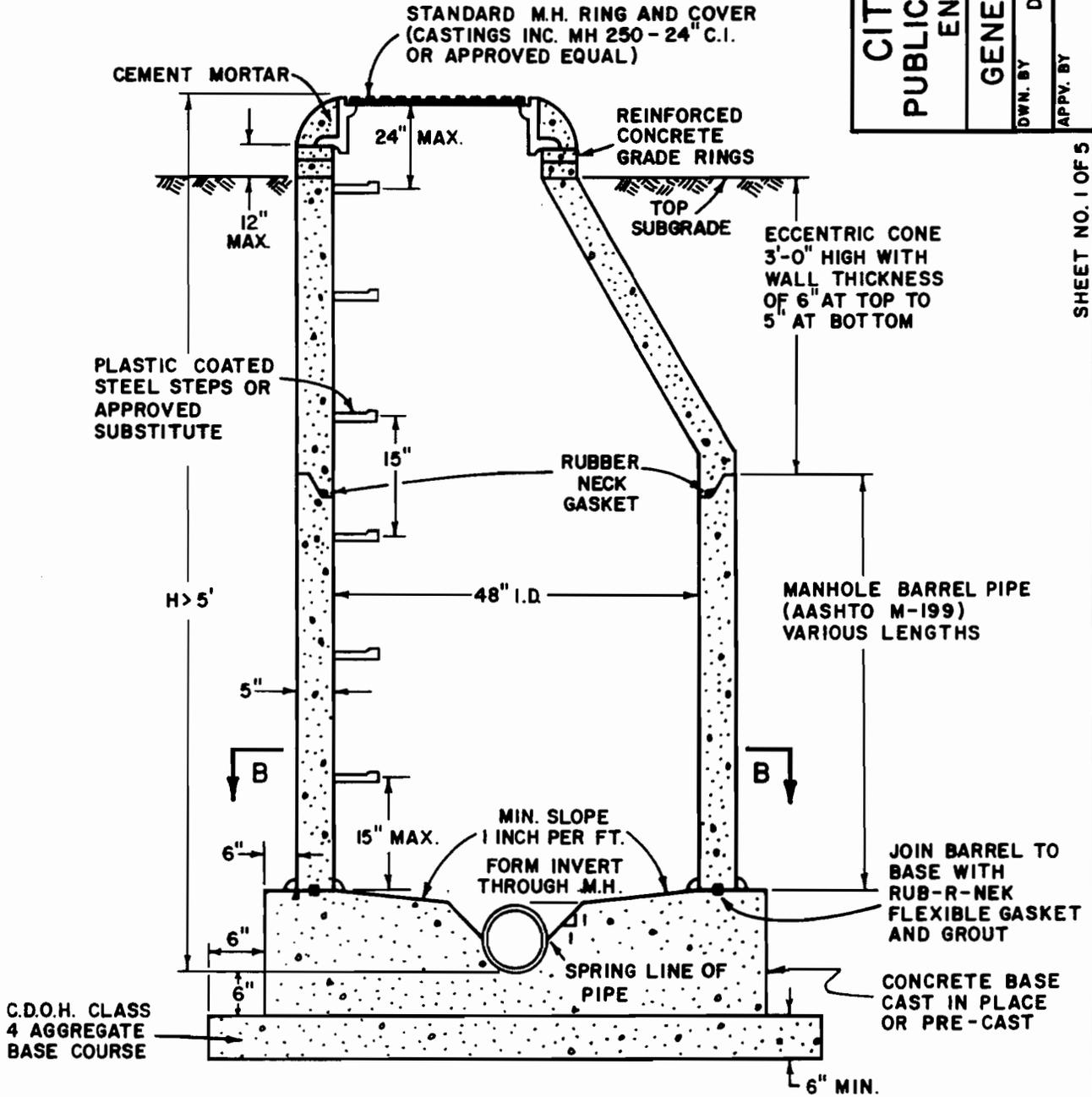
SECTIONAL ELEVATION CROSS SECTION

STANDARD LIFT STATION DETAILS

MANHOLE NOTES

1. CONCRETE SHALL BE COLORADO DIVISION OF HIGHWAYS CLASS "B" (SECTION 601.02)
2. ALL CEMENT USED IN MORTAR, CONCRETE BASES, GRADE RINGS, RISER SECTIONS, CONES, AND FLAT TOPS, FOR SANITARY SEWER MANHOLES, SHALL BE TYPE I OR MODIFIED TYPE II PORTLAND CEMENT WITH LESS THAN 5% TRICALCIUM ALUMINATE.
3. MANHOLE RISER SECTIONS, CONES, FLAT TOPS, AND GRADE RINGS SHALL BE PRECAST REINFORCED CONCRETE CONFORMED TO ASTM C-478 OR AASHTO M-199.
4. FOR INLET SIZES GREATER THAN 36" DIAMETER A 60" DIAMETER MANHOLE WILL BE REQUIRED.

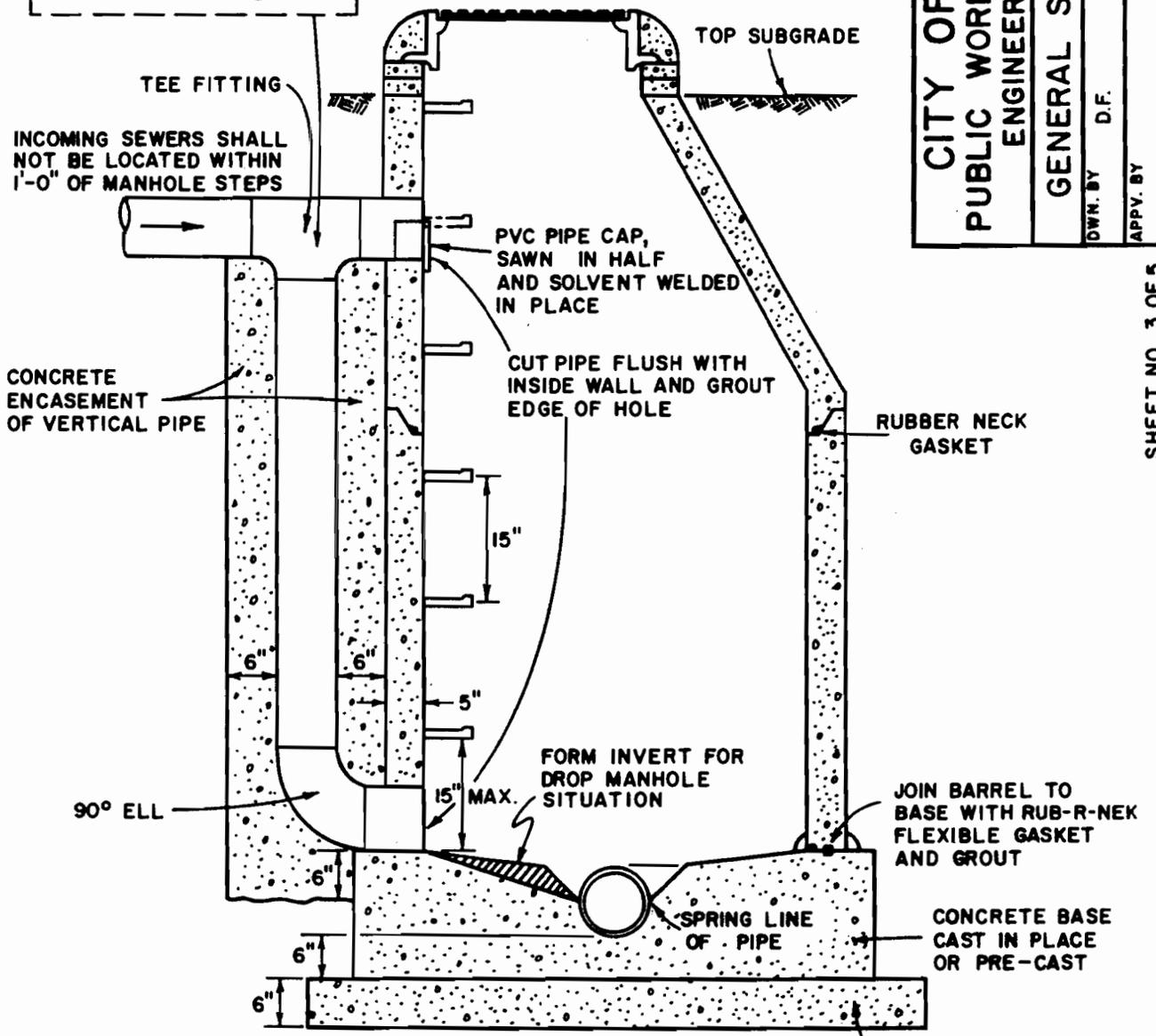
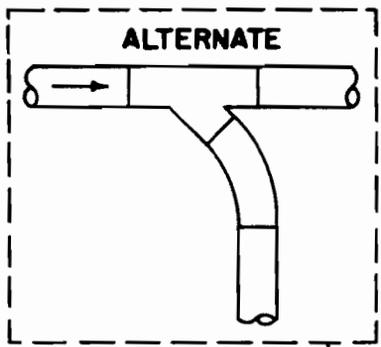
CITY OF DURANGO PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION	GENERAL SPECIFICATIONS	
	DWN. BY D. F.	DATE 11-30-83
	APPV. BY S-4	



STANDARD MANHOLE

SHEET NO. 1 OF 5

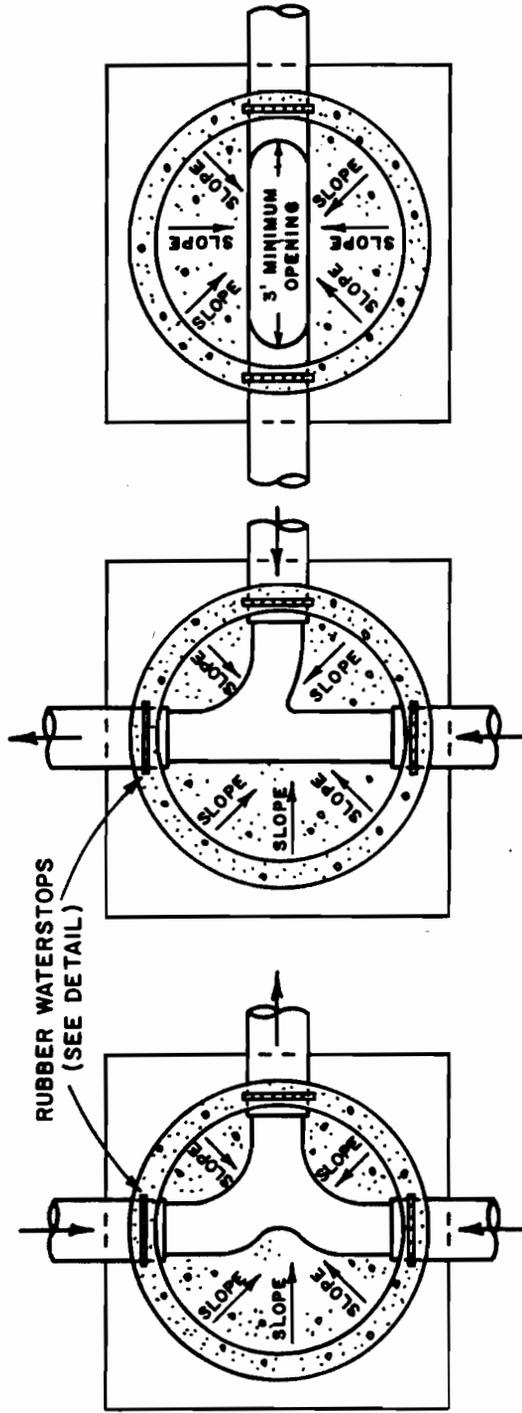
CITY OF DURANGO PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION		DATE	11-30-83
		DWN. BY	D.F.
GENERAL SPECIFICATIONS		APPV. BY	DWG. NO. S-4



DROP MANHOLE

NOTE:
 DROP MANHOLE SHALL BE PROVIDED WHERE SEWER ENTERS M.H. 2'-0" OR MORE ABOVE LOWEST INVERT OF MANHOLE. MANHOLES > 5' DEEP MEASURED FROM INVERT TO TOP OF RIM SHALL USE ECCENTRIC CONICAL TOP SECTION.

SHEET NO. 3 OF 5

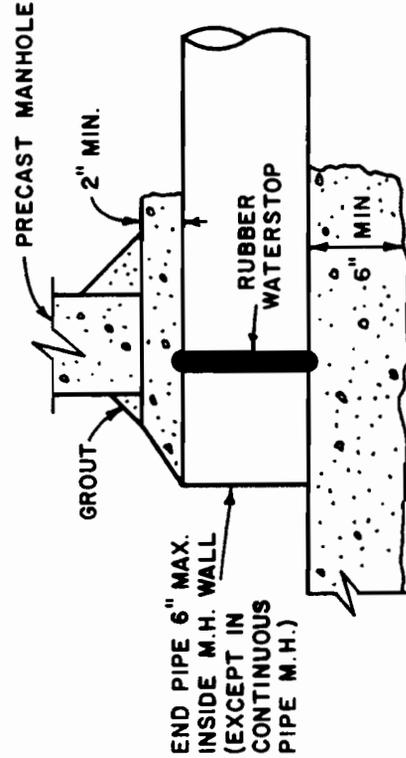


"T" JUNCTION

"Y" JUNCTION

CONTINUOUS PIPE
 NOTE: LAY PIPE CONTINUOUSLY THROUGH MANHOLE WHEN THERE IS NO CHANGE IN GRADE OR ALIGNMENT.

SECTION B-B

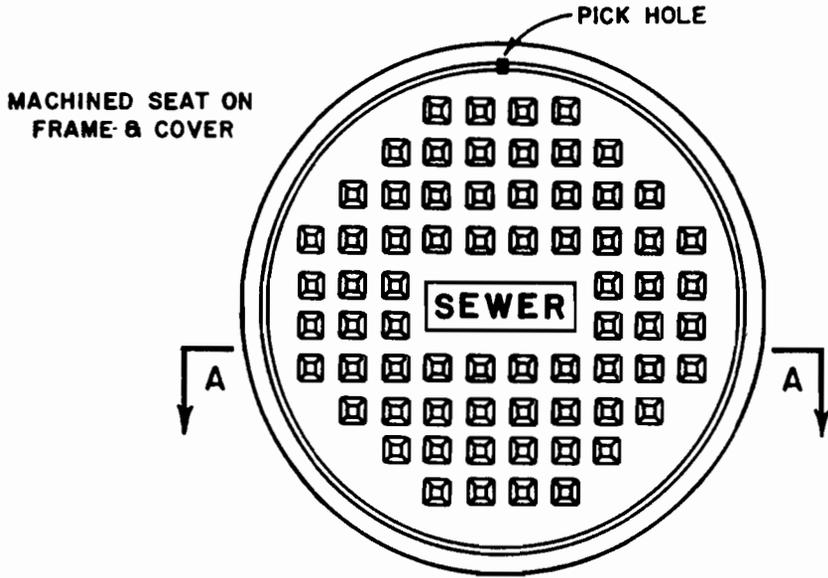


PIPE ENTRANCE INTO MANHOLE

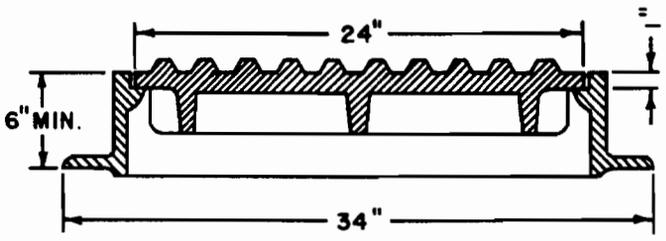
CITY OF DURANGO PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION	
GENERAL SPECIFICATIONS	
DWN. BY D. F.	DATE 11-30-83
APPV. BY	DWG. NO. S-4

STANDARD M.H. RING AND COVER
 (NEENAH R-1657, J' MARK J-1103,
 CASTINGS INC. MH 250-24" C.I. OR
 APPROVED EQUAL)

CITY OF DURANGO	
PUBLIC WORKS DEPARTMENT	
ENGINEERING DIVISION	
GENERAL SPECIFICATIONS	
DWN. BY	D.F.
DATE	11-30-83
APPV. BY	DWG. NO. S-4



COVER



SECTION A-A (RING)

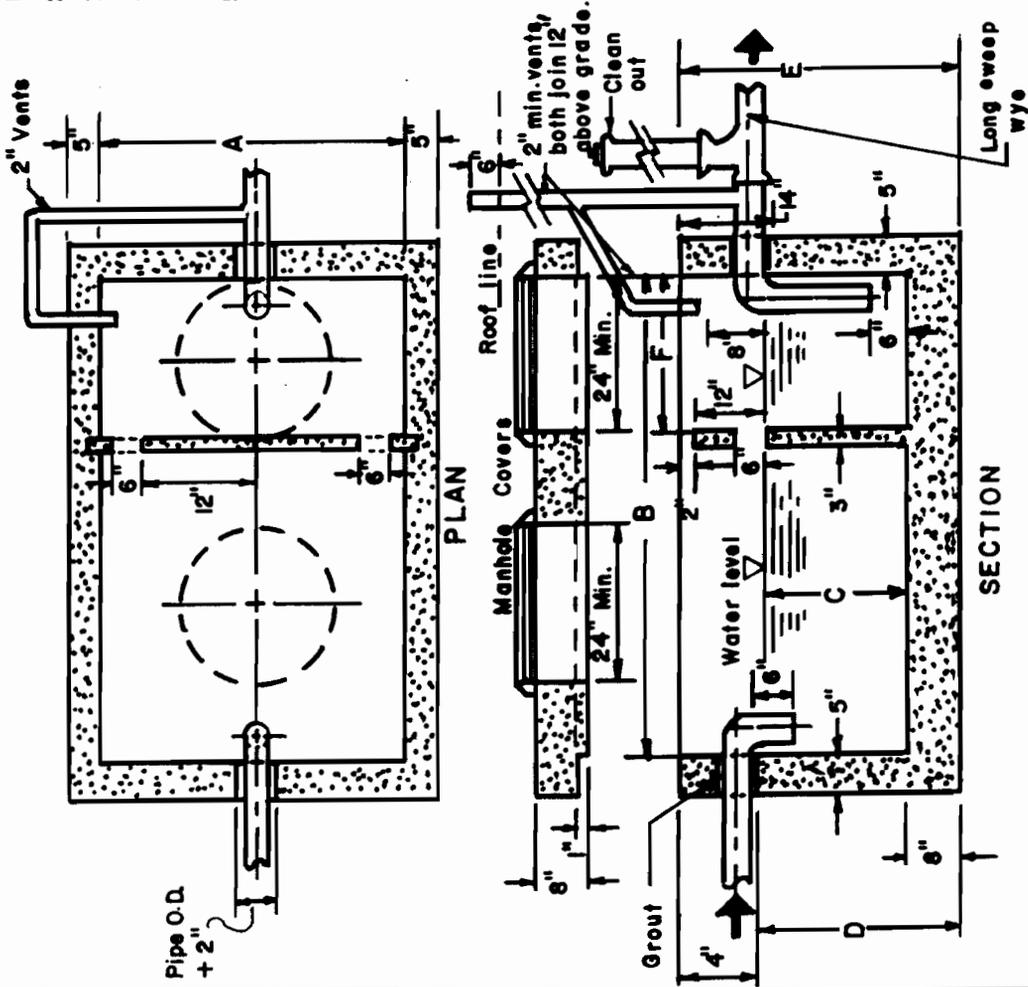
**STANDARD CAST IRON MANHOLE
 RING & COVER**

SHEET NO. 5 OF 5

SAND & OIL INTERCEPTOR TYPE "A" COMMERCIAL

NOTES:

1. All pipe & fittings to be cast iron, 3" min. diameter.
2. Small compartment has 1/3rd of the total capacity.
3. Walls & bottom reinforced throughout with 2x16 #10 rebar.
4. Covers to be reinforced longitudinally with no. 6 rebar on 6" centers, no. 4 rebar on 6" centers widthwise, & no. 8 rebar diagonally around access holes.
5. Clean out shall be an iron body ferrule.
6. Vent pipe shall be cast iron to a point 6" above ground.
7. Manhole ring & cover shall be J-Mark No. 1161 or equal.
8. Check with SUPPLIER for EXACT DIMENSIONS.
9. NO BOLT DOWN COVERS ALLOWED without permission from Durango Wastewater Division.



WATER CAPACITY APPROX. GALLONS	DIMENSIONS					
	TWO COMPARTMENT TANK IN INCHES					
	A	B	C	D	E	F
320	48	72	22	30	44	24
500	48	72	36	46	58	24
780	48	96	40	48	62	20
1060	72	102	34	42	56	30

**CITY OF DURANGO
PUBLIC WORKS DEPARTMENT
ENGINEERING DIVISION**

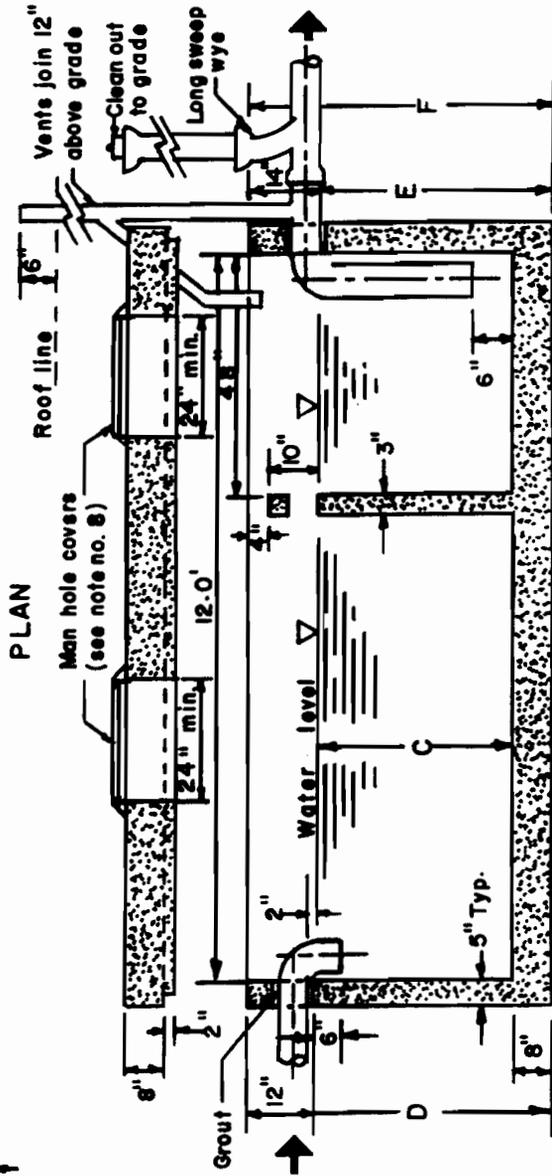
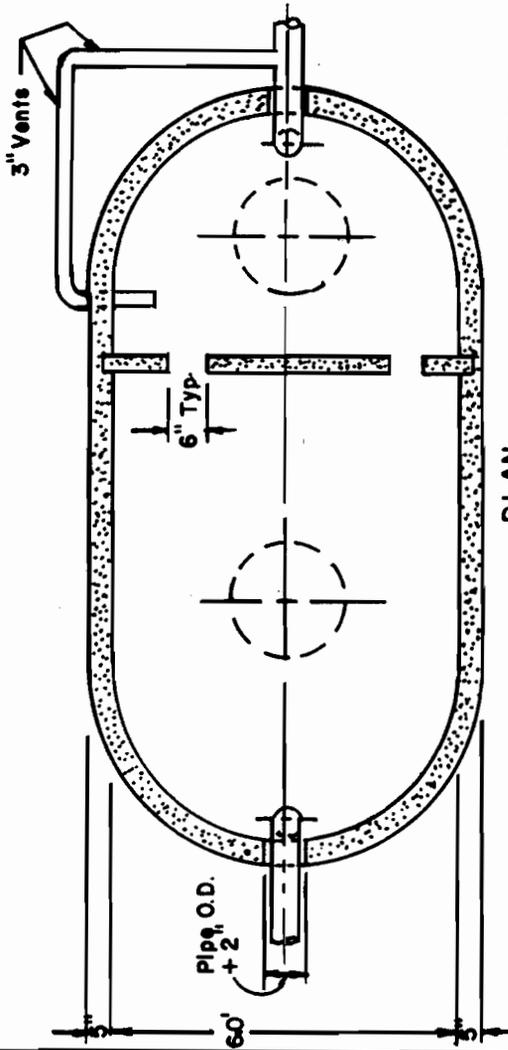
GENERAL SPECIFICATIONS

DWN. BY A. G. W. DATE 12-15-82

APPV. BY DWG. NO. S-5

SAND & OIL INTERCEPTOR TYPE "B" INDUSTRIAL

- NOTES:**
1. Secondary compartment has volume equal to 1/3 of total capacity.
 2. All pipe & fittings to be cast iron, 3" dia. min.
 3. Walls & bottom reinforced throughout with 2x16 6/10 re mesh.
 4. Covers to be reinforced longitudinally with no. 6 rebar on 6" centers, no. 4 rebar on 6" centers widthwise, & no. 8 rebar diagonally around access holes.
 5. Cleanout shall be an iron body ferrule with brass screw plug.
 6. Vent pipe shall be cast iron to a point 6" above ground level.
 7. Manhole ring & cover shall be J-Mark 1161 or approved equal.
 8. **NO BOLT DOWN COVERS ALLOWED** without permission from the Durango Wastewater Dept.
 9. CHECK with SUPPLIER for EXACT DIMENSIONS.



Water Capacity Gallons (approx)	Dimensions - inches			
	C	D	E	F
1565	40	50	48	62
1800	46	56	54	68
2035	52	62	60	74
2505	64	74	72	86
2975	76	86	84	98
3210	82	92	90	104
3445	88	98	96	110

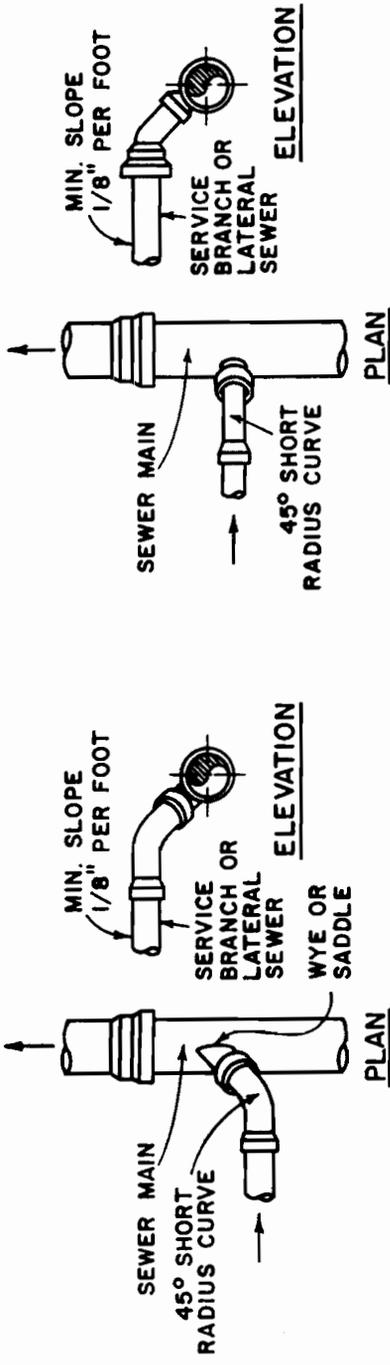
CITY OF DURANGO
PUBLIC WORKS DEPARTMENT
ENGINEERING DIVISION

GENERAL SPECIFICATIONS

DWN. BY A.G.W. DATE 12-16-82

APPV. BY _____ DWG. NO. S-5

SECTION



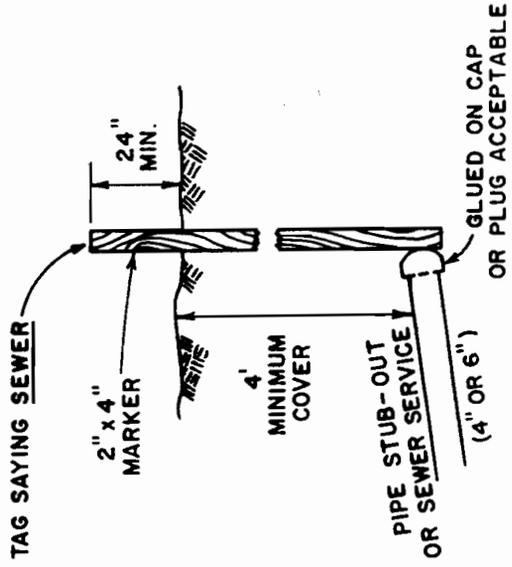
"Y" TYPE

"T" TYPE

SERVICE CONNECTIONS

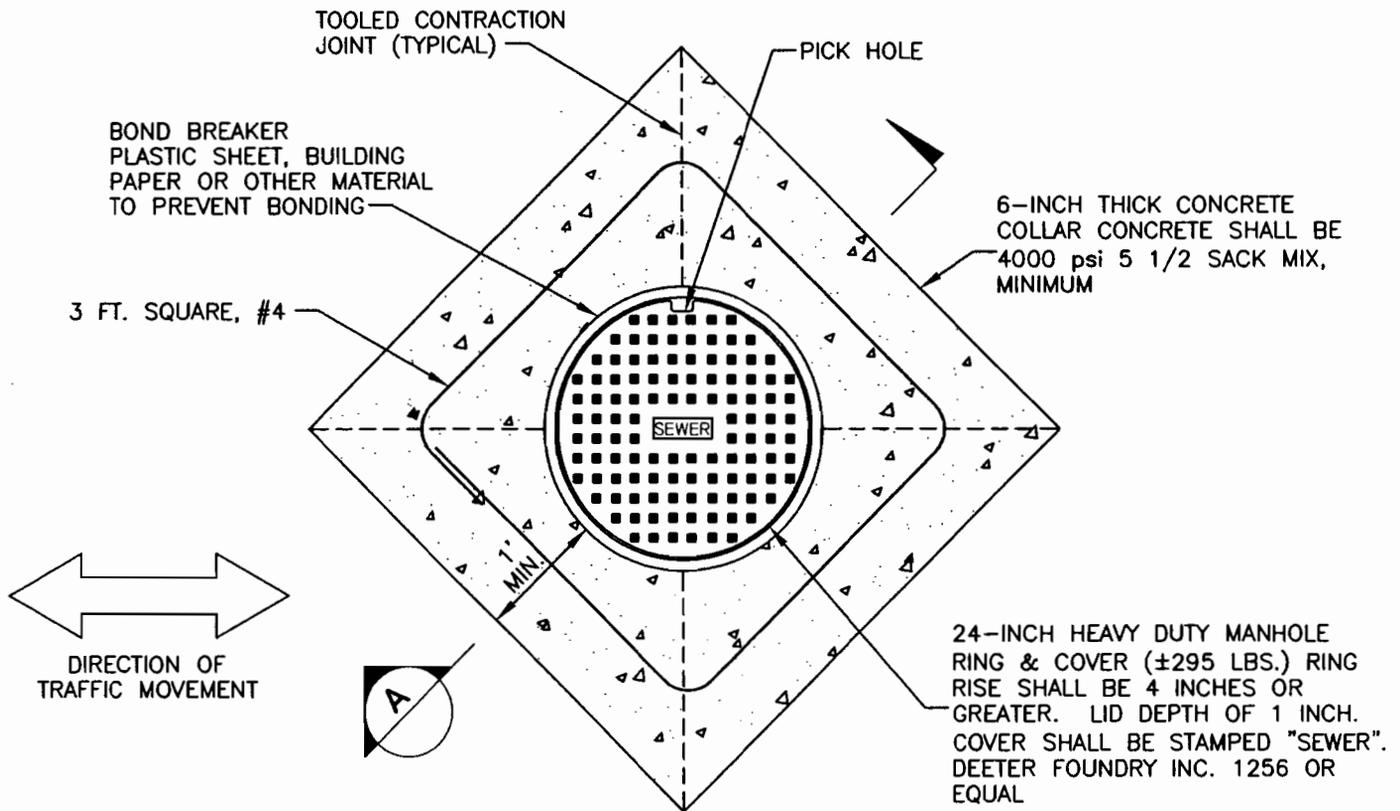
NOTE:

- 1. SEWER TAP TO BE MADE UNDER DIRECTION OF MASTER PLUMBER.
- 2. SADDLES TO BE APPROVED BY SEWER SUPERINTENDENT PRIOR TO INSTALLATION.

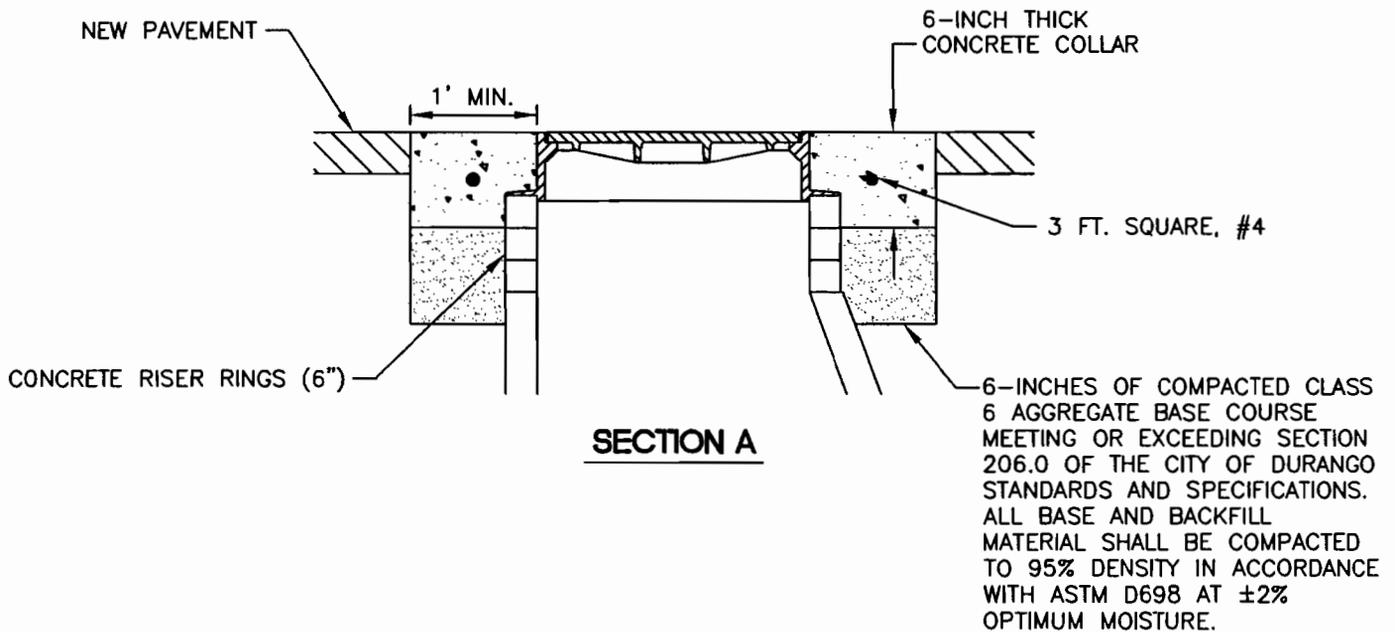


SEWER SERVICE MARKER

CITY OF DURANGO	
PUBLIC WORKS DEPARTMENT	
ENGINEERING DIVISION	
GENERAL SPECIFICATIONS	
DWN. BY	DATE
D.F.	11-30-83
APPV. BY	DWG. NO.
	S-6



PLAN VIEW



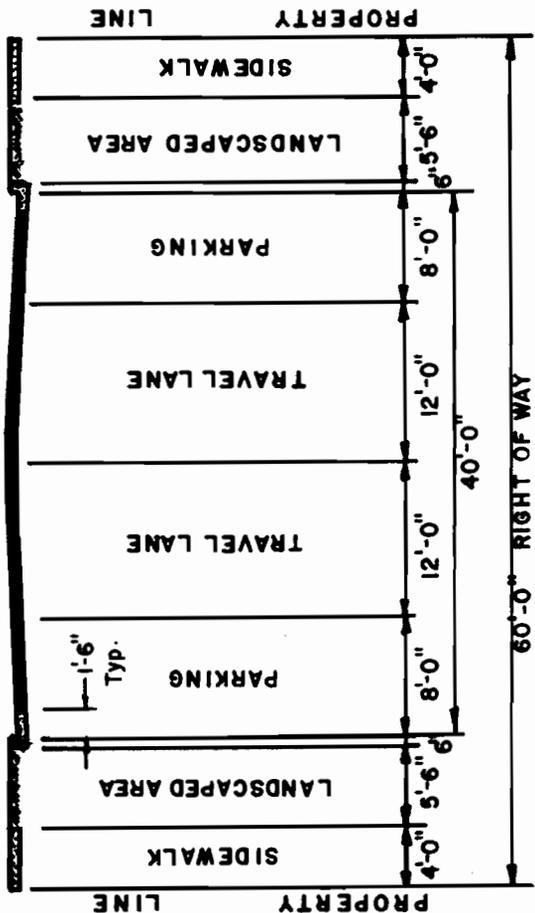
SECTION A

CONCRETE MANHOLE COLLAR DETAIL

Not to Scale

S-7

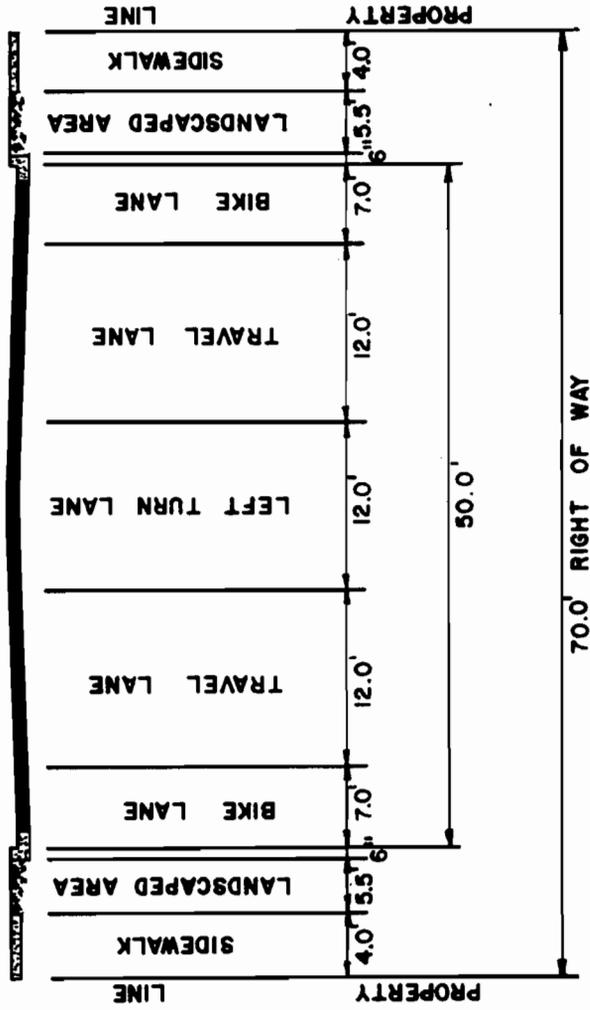
TYPICAL CROSS-SECTION - LOCAL STREET



CITY OF DURANGO	
PUBLIC WORKS DEPARTMENT	
ENGINEERING DIVISION	
GENERAL SPECIFICATIONS	
OWN. BY A. G. W.	DATE 12-28-82
APPV. BY	DWG. NO. R-1A

TYPICAL CROSS-SECTION — COLLECTOR STREET

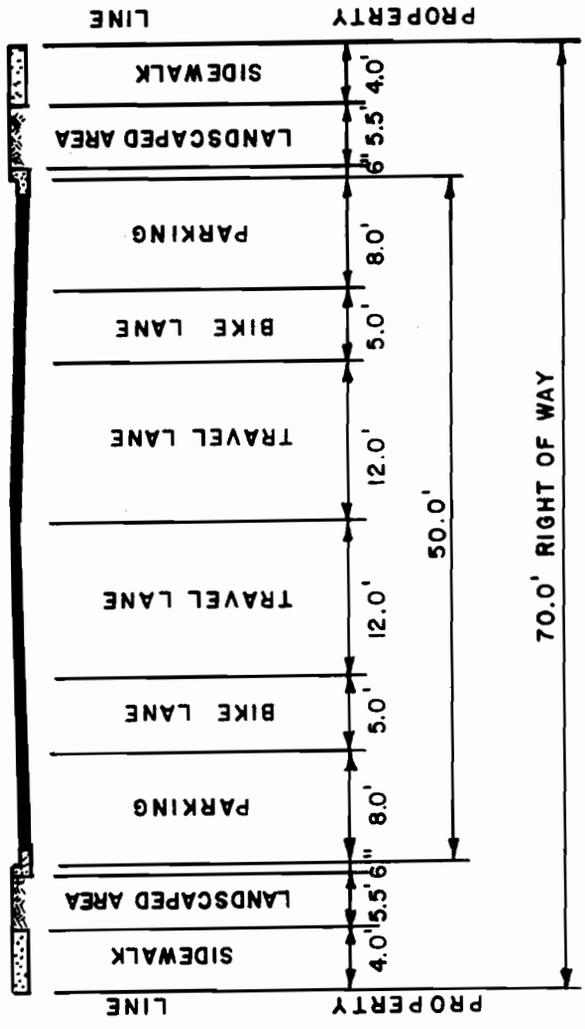
ALTERNATE I



CITY OF DURANGO	
PUBLIC WORKS DEPARTMENT	
ENGINEERING DIVISION	
GENERAL SPECIFICATIONS	
DWN. BY N.B.P.A.	DATE 5-6-83
APPV. BY	DWG. NO. R-1B

TYPICAL CROSS-SECTION — COLLECTOR STREET

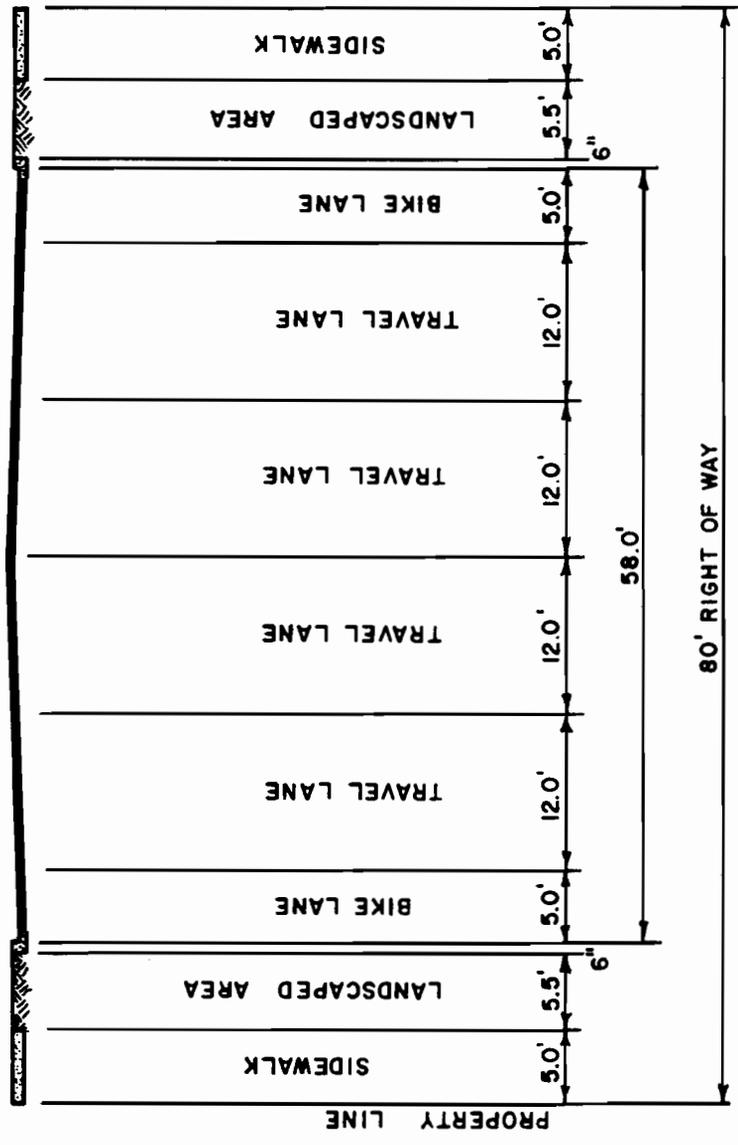
ALTERNATE 2



CITY OF DURANGO	
PUBLIC WORKS DEPARTMENT	
ENGINEERING DIVISION	
GENERAL SPECIFICATIONS	
DWN. BY A.G.W.	DATE 12-29-82
APPV. BY	DWG. NO. R-1C

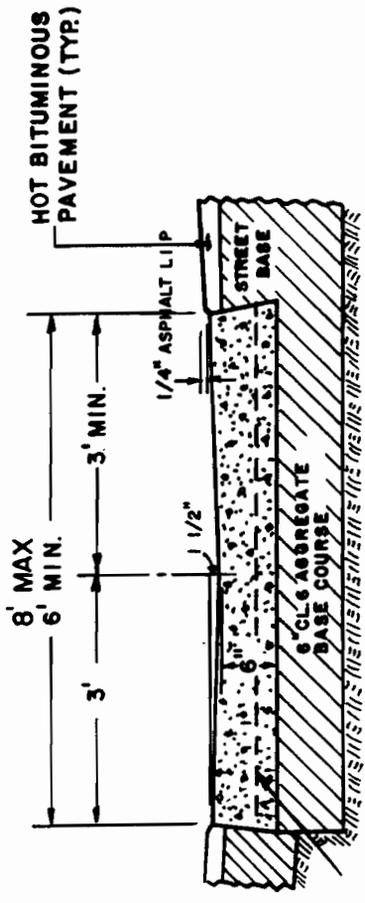
TYPICAL CROSS-SECTION

ARTERIAL STREET



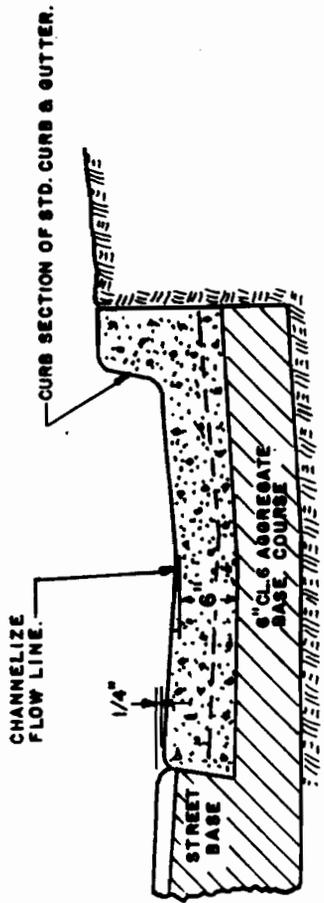
CITY OF DURANGO	
PUBLIC WORKS DEPARTMENT	
ENGINEERING DIVISION	
GENERAL SPECIFICATIONS	
DWN. BY	D.F.
DATE	11-30-83
APPV. BY	DWG. NO. R-ID

STANDARD CROSS GUTTER

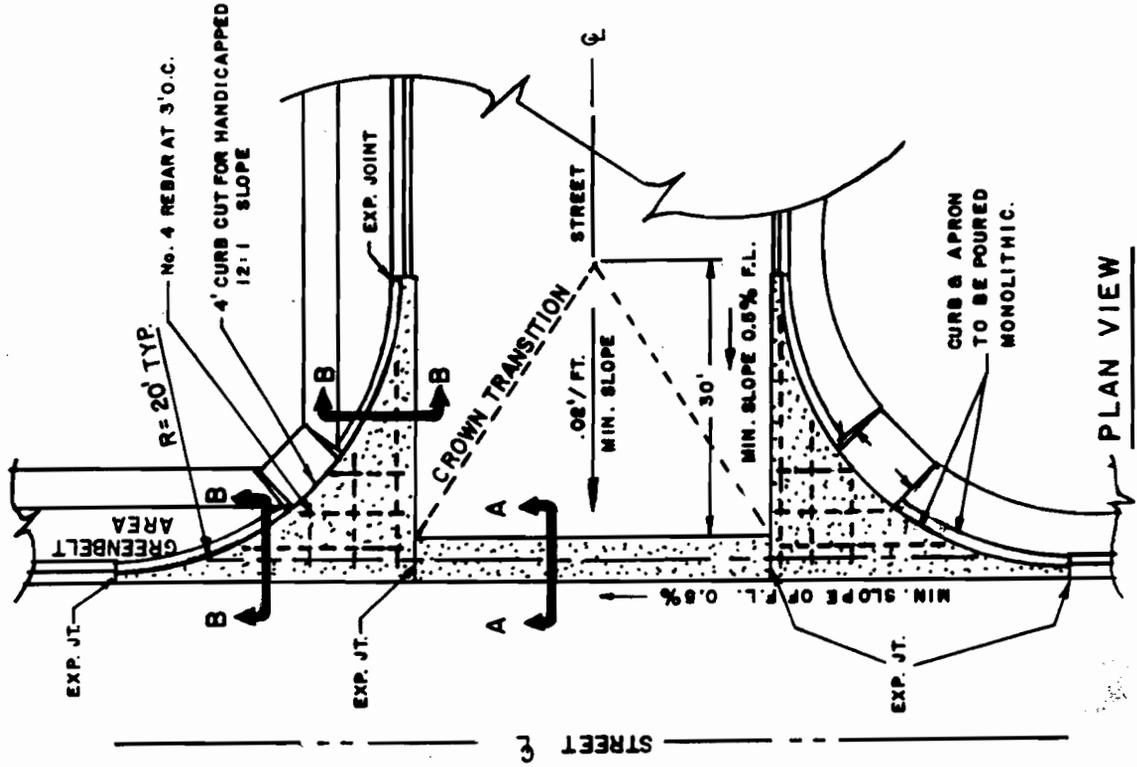


Entire valley gutter to be reinforced with 6" x 6 no. 10 woven wire fabric

SECTION A - A



SECTION B - B



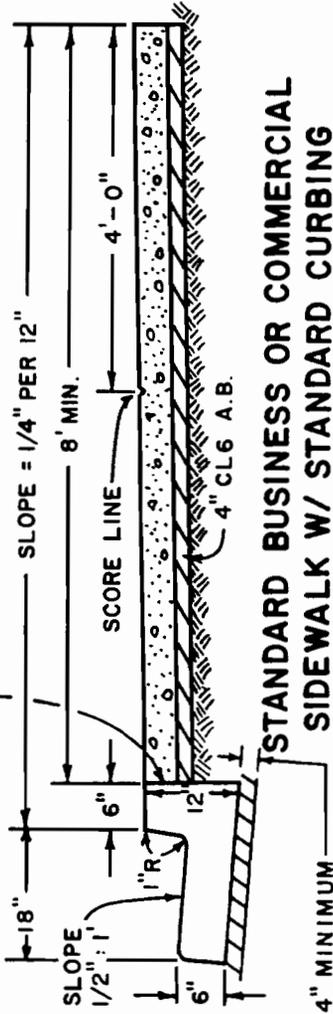
PLAN VIEW

REVISED 1/9/92 L.F.

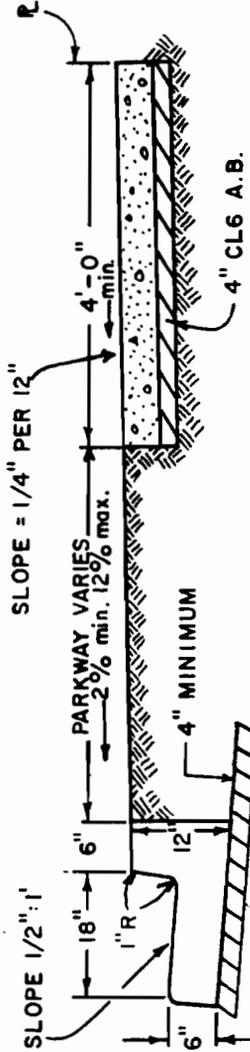
Valley gutters are not to be used standard design for crossing water across collector or arterial roadways.

CITY OF DURANGO	
PUBLIC WORKS DEPARTMENT	
ENGINEERING DIVISION	
GENERAL SPECIFICATIONS	
DWN. BY	DATE
A.G.W.	12-30-82
APPV. BY	DWG. NO.
	R-2

EXPANSION JOINT WITH JOINT SEALER APPROVED BY CITY ENGINEER



**STANDARD BUSINESS OR COMMERCIAL
SIDEWALK W/ STANDARD CURBING**



**STANDARD RESIDENTIAL SIDEWALK
W/ STANDARD CURBING**

NOTE: EXTEND BASE 1'
BEYOND CONCRETE

1/8" → 1/4" OF THE CONCRETE
THICKNESS



TYPICAL EXPANSION JOINT
TYPICAL CONTRACTION JOINT

NOTE:

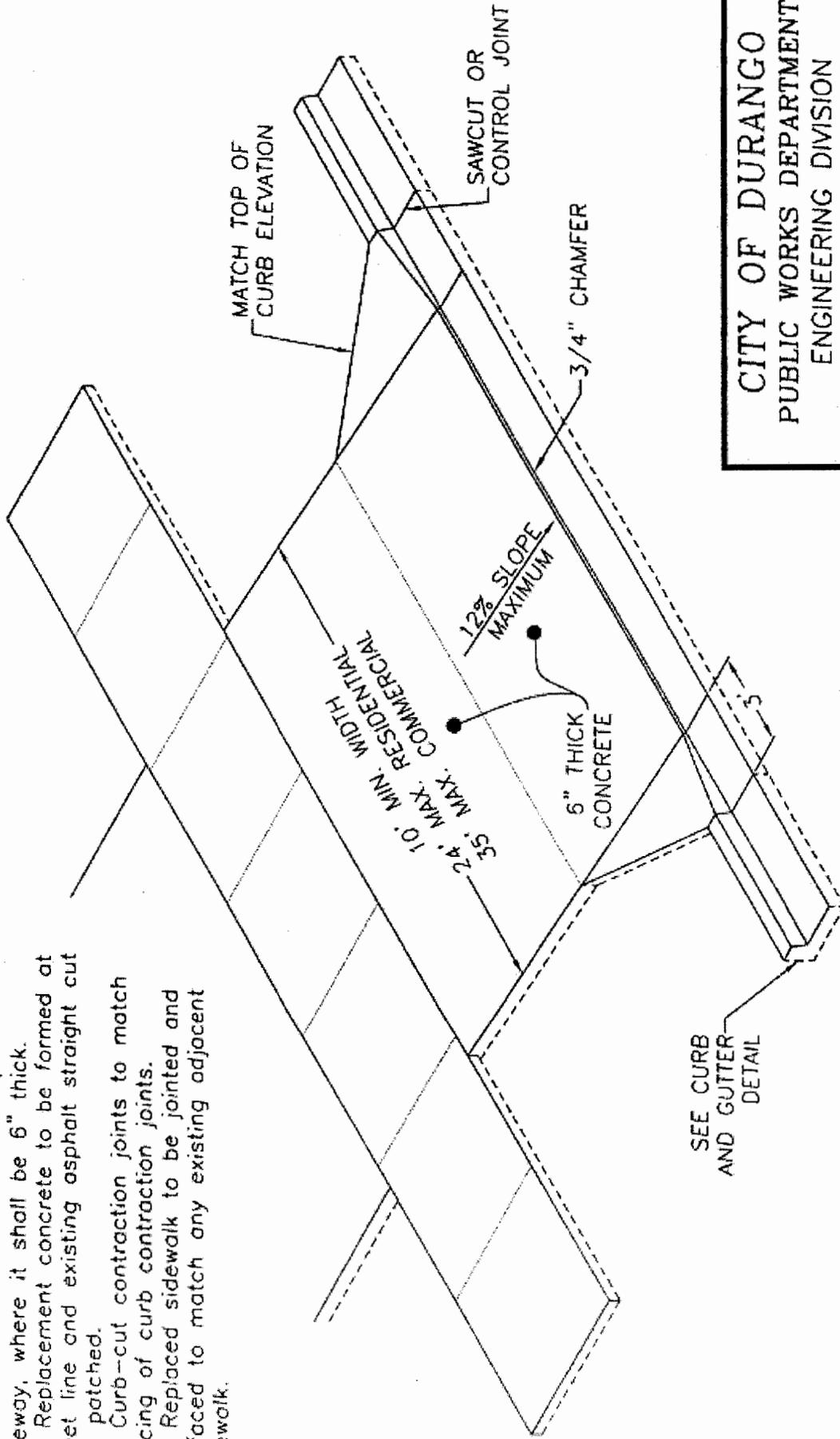
1. ALL SIDEWALKS TO BE 4" THICK, EXCEPT AT DRIVEWAYS, SIDEWALK SHALL BE 6" THICK.
2. ON STRAIGHT RUN OF STANDARD SIDEWALK, 1/4" EXPANSION JOINTS SHALL BE INSTALLED 80' ON-CENTER AND CONTRACTION JOINTS SHALL BE INSTALLED AT INTERVALS NOT TO EXCEED 10'.
3. SIDEWALKS SHALL BE A MINIMUM OF 6' WIDE ON ARTERIAL STREETS AND ADJACENT TO SCHOOLS.
4. WIDER SIDEWALKS MAY BE REQUIRED BY THE ENGINEER WHEN DETERMINED NECESSARY TO CARRY PEDESTRIAN/BIKE TRAFFIC AND/OR TO CONFORM WITH THE EXISTING NEIGHBORHOOD.
5. COMMERCIAL SIDEWALK SHALL BE SEPARATED FROM CURB WHEN SUFFICIENT ROW PERMITS.
6. PARKWAY TO BE DETERMINED BY AVAILABLE RIGHT OF WAY. IF LESS THAN 2', PLACE SIDEWALK ADJACENT TO CURB.
7. ROLL-OVER STYLE CURB, GUTTER AND SIDEWALK SHALL ONLY BE INSTALLED WHEN REPLACING EXISTING SECTIONS OF THIS TYPE OF CURB/WALK LESS THAN 20' IN LENGTH.
8. THE TYPICAL SECTION OF THE STANDARD CURB SHALL BE MODIFIED AT TIE-IN POINTS IN ORDER TO PRODUCE A SUITABLE TRANSITION TO THE EXISTING CURB SECTION. VARIABLE HEIGHT CURB (OTHER THAN 6" MEASURED ALONG THE FACE OF THE CURB) SHALL BE CONSTRUCTED TO MATCH AN EXISTING SIDEWALK OR AS DIRECTED BY THE ENGINEER.

REVISED 1/9/92 L.F.

CITY OF DURANGO	
PUBLIC WORKS DEPARTMENT	
ENGINEERING DIVISION	
GENERAL SPECIFICATIONS	
DWN. BY	D. F.
DATE	11-30-83
APPV. BY	DWG. NO. R-3

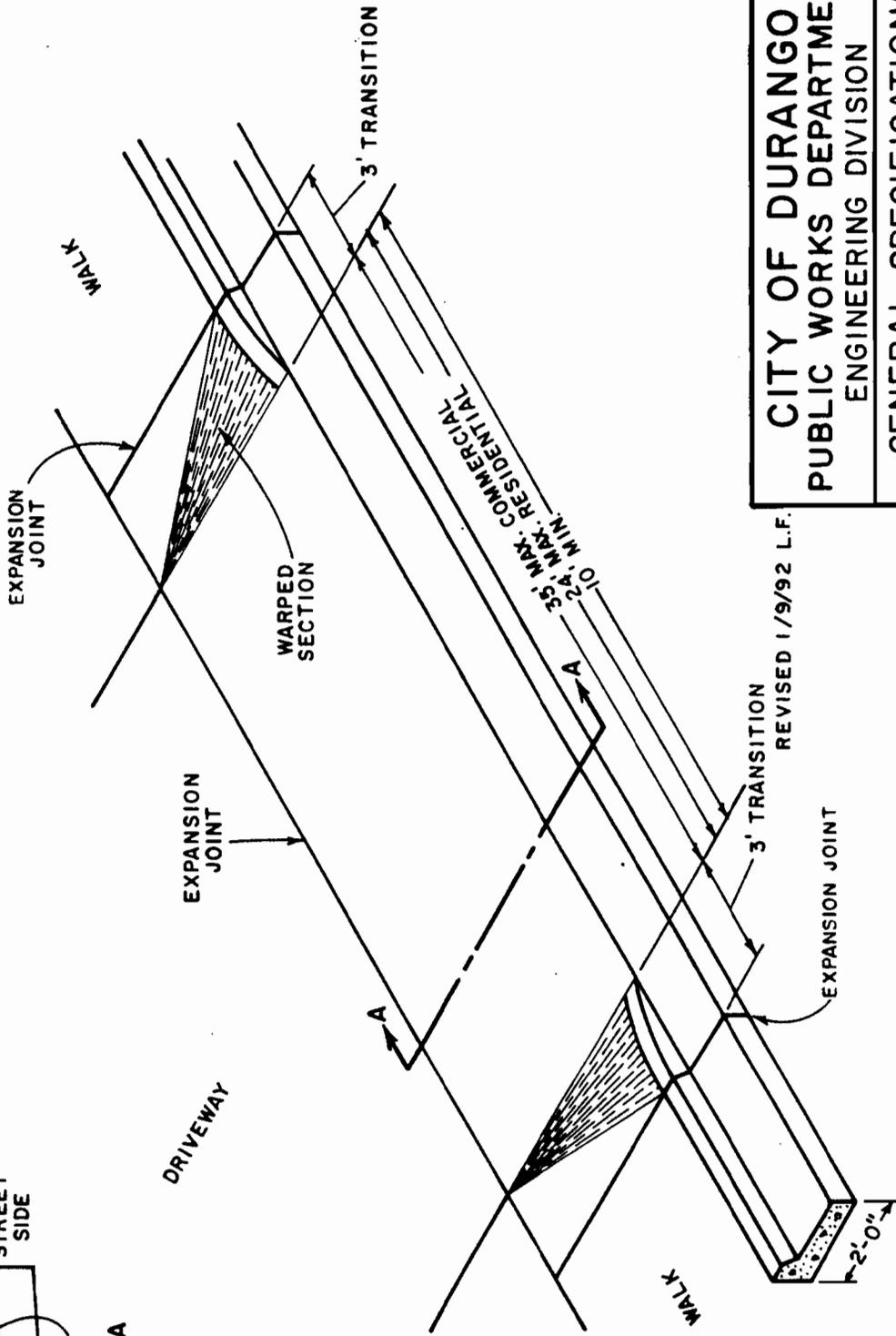
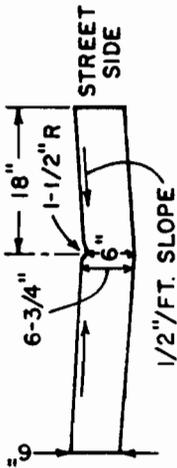
NOTES:

1. Sidewalk to be 4" thick except in driveway, where it shall be 6" thick.
2. Replacement concrete to be formed at street line and existing asphalt straight cut and patched.
3. Curb-cut contraction joints to match spacing of curb contraction joints.
4. Replaced sidewalk to be jointed and surfaced to match any existing adjacent sidewalk.



CITY OF DURANGO	
PUBLIC WORKS DEPARTMENT	
ENGINEERING DIVISION	
Driveway or Alley Return for	
Locations with Separated Sidewalk	
Drawn by	M.H.
Date	12-12-99
Approved by	G.B.
Drawing No.	R-4

DRIVEWAY OR ALLEY RETURN FOR LOCATIONS WITH AN ADJACENT SIDEWALK



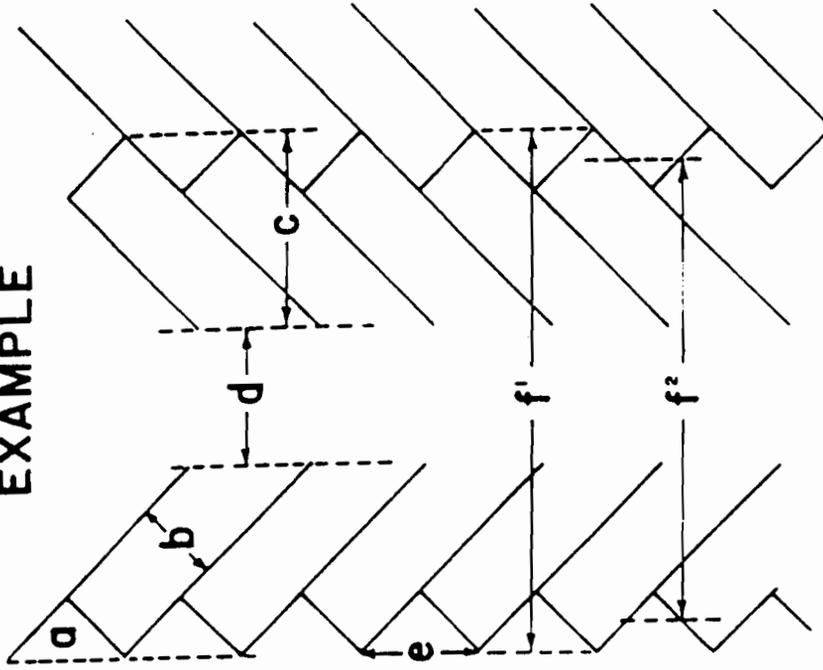
REVISED 1/9/92 L.F.

CITY OF DURANGO	
PUBLIC WORKS DEPARTMENT	
ENGINEERING DIVISION	
GENERAL SPECIFICATIONS	
DWN. BY	D.F.
DATE	8-23-84
APPV. BY	R-5

STANDARD OFF STREET
PARKING REQUIREMENTS

a	b	c	d	e	f'	f''
PARKING ANGLE	STALL WIDTH	STALL TO CURB (19' LONG STALL)	AISLE WIDTH	CURB LENGTH PER CAR	CENTER TO CENTER WIDTH OF TWO-ROW BIN WITH ACCESS ROAD BETWEEN CURB TO OVERLAP CURB C-C	CENTER TO CENTER WIDTH OF TWO-ROW BIN WITH ACCESS ROAD BETWEEN CURB TO OVERLAP CURB C-C
0°	8'		12'	20'		
30°	8'	16.4'	15'	16.0'	47.8'	40.8'
	8'-6"	16.8'	14'	17.0'	47.6'	40.2'
	9'	17.3'	13'	18.0'	47.6'	39.8'
	9'-6"	17.7'	12'	19.0'	47.4'	39.2'
45°	8'	19.1'	19'	11.3'	57.2'	51.6'
	8'-6"	19.4'	16'	12.0'	54.8'	49.8'
	9'	19.7'	15'	12.7'	54.4'	48.0'
	9'-6"	20.1'	14'	13.4'	54.2'	47.4'
60°	8'	20.5'	22'	9.2'	63.0'	61.0'
	8'-6"	20.7'	20'	9.8'	61.4'	57.2'
	9'	20.9'	19'	10.4'	60.8'	56.2'
	9'-6"	21.2'	18'	10.9'	60.4'	55.6'
90°	8'	20.0'	29'	8.0'	69.0'	
	8'-6"	20.0'	26'	8.5'	66.0'	
	9'	20.0'	25'	9.0'	65.0'	
	9'-6"	20.0'	24'	9.5'	64.0'	

EXAMPLE

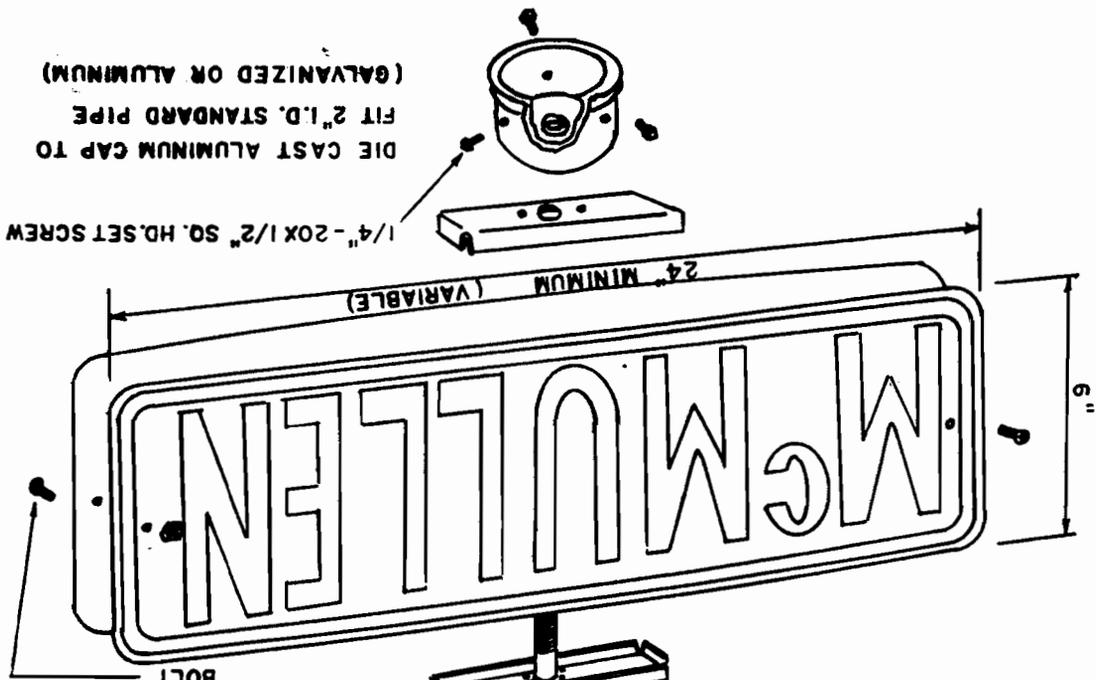


FOR TWO-WAY FLOW THE MINIMUM AISLE WIDTH IS 24'

CITY OF DURANGO	
PUBLIC WORKS DEPARTMENT	
ENGINEERING DIVISION	
GENERAL SPECIFICATIONS	
DWN BY	D.F.
DATE	2-7-84
APPV. BY	R-6

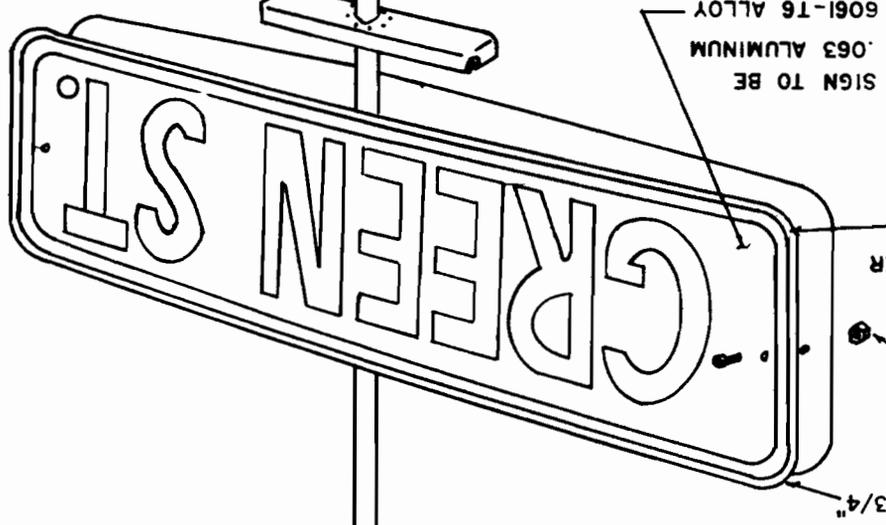
**CITY OF DURANGO
PUBLIC WORKS DEPARTMENT
ENGINEERING DIVISION
GENERAL SPECIFICATIONS**

DWN. BY W. M. M. DATE 11-28-77
APPV. BY DWG. NO. R-7



NO. 8-32 PHILLIPS
HEAD ALUMINUM
BOLT

1/8" MALE SEPARATOR
.080 ALUMINUM ALLOY



6061-T6 ALLOY
.063 ALUMINUM
SIGN TO BE

1/4" WIDE BLACK BORDER
INSET 1/8" FROM EDGE
OF SIGN

NO. 8-32 HEX.
ALUMINUM NUT

ALL RADII TO BE 3/4"

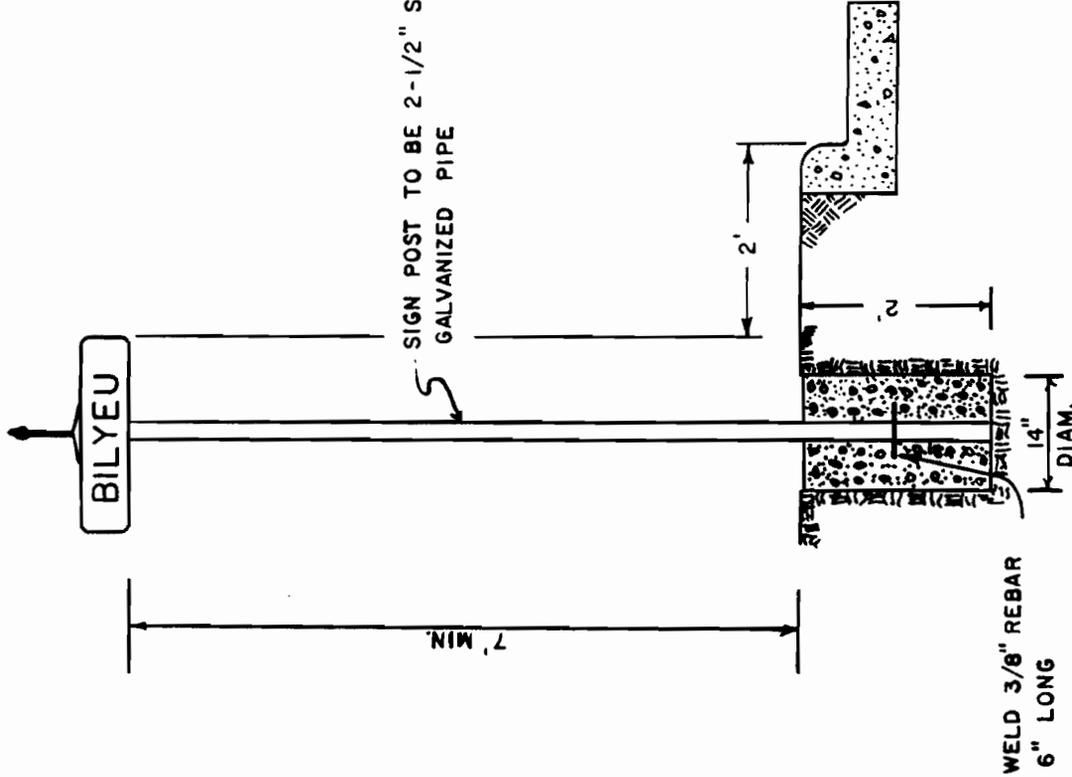
SEPARATOR ALUMINUM
1/8" x 6" FEMALE

GALVANIZED OR ALUMINUM
CENTER ROD 1/2" x 19 1/2"

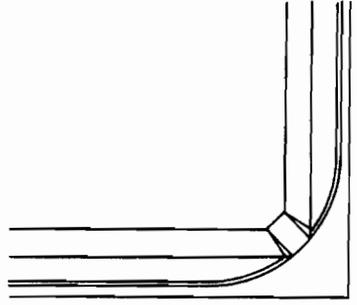
NAME PLATE
TOTAL HEIGHT 6", WIDTH 24" MIN.
BACKGROUND 3M220 SCOTCHLITE
4" LETTERS, B.P.R. (BUREAU OF
PUBLIC ROADS) SERIES C

NOTE: LOWER SIGN AND
ATTACHMENTS TO BE
SAME AS UPPER
ZINK OR ALUMINUM 1/2"
THEFT PROOF CAP NUT

SEE CITY STANDARD
FOR STREET NAME SIGN



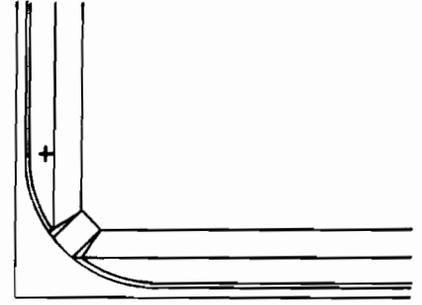
STREET NAME SIGNS SHOULD
BE PLACED ON DIAGONALLY
OPPOSITE CORNERS SO THEY
WILL BE ON THE FAR RIGHT-
HAND SIDE OF THE INTERSECTION
FOR TRAFFIC ON THE MAJOR
STREET.



STREET

MAJOR

STREET

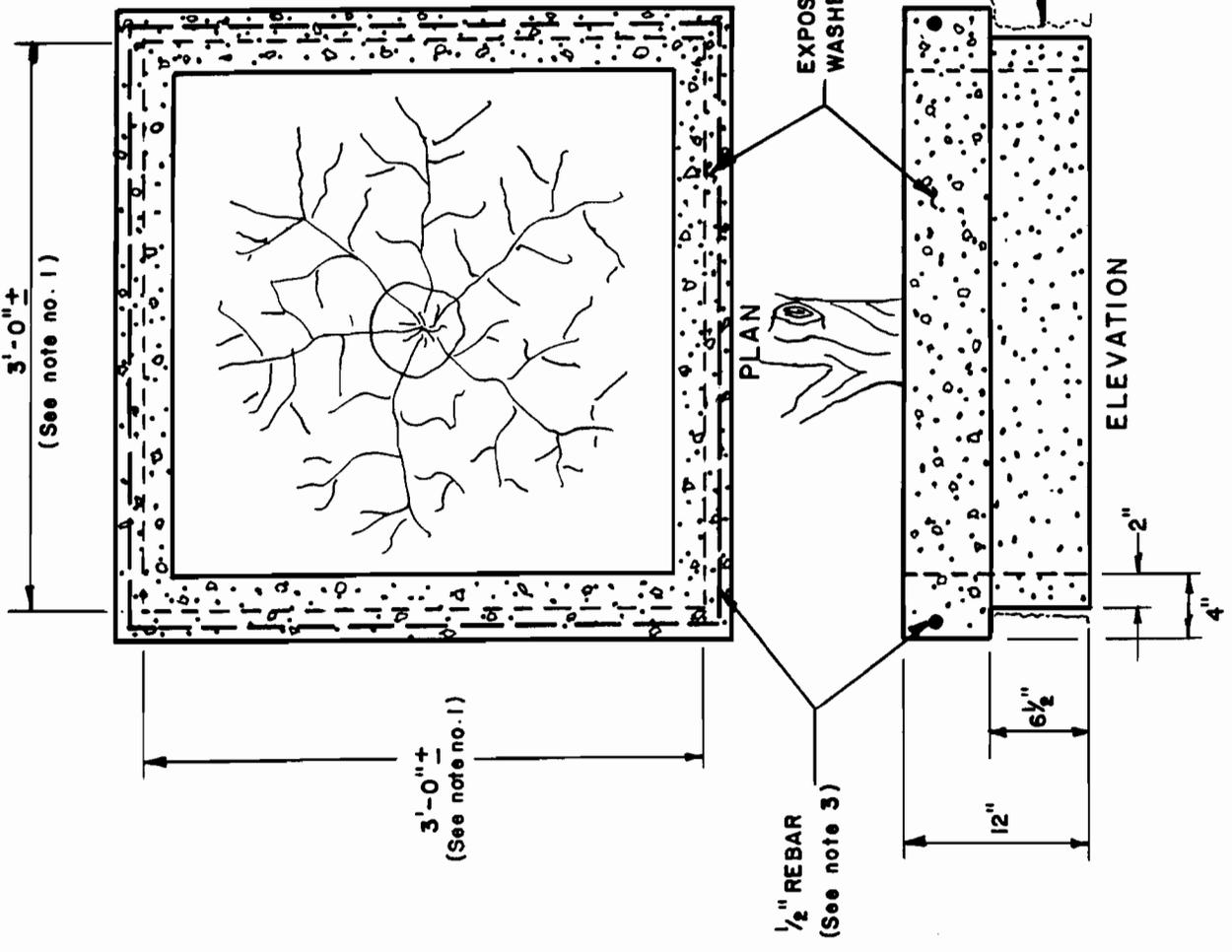


MINOR

LOCATION

CITY OF DURANGO	
PUBLIC WORKS DEPARTMENT	
ENGINEERING DIVISION	
GENERAL SPECIFICATIONS	
DWN. BY	W. M. M.
DATE	11-21-77
APPV. BY	
DWG. NO.	R-7

STREET PLANTER DETAIL



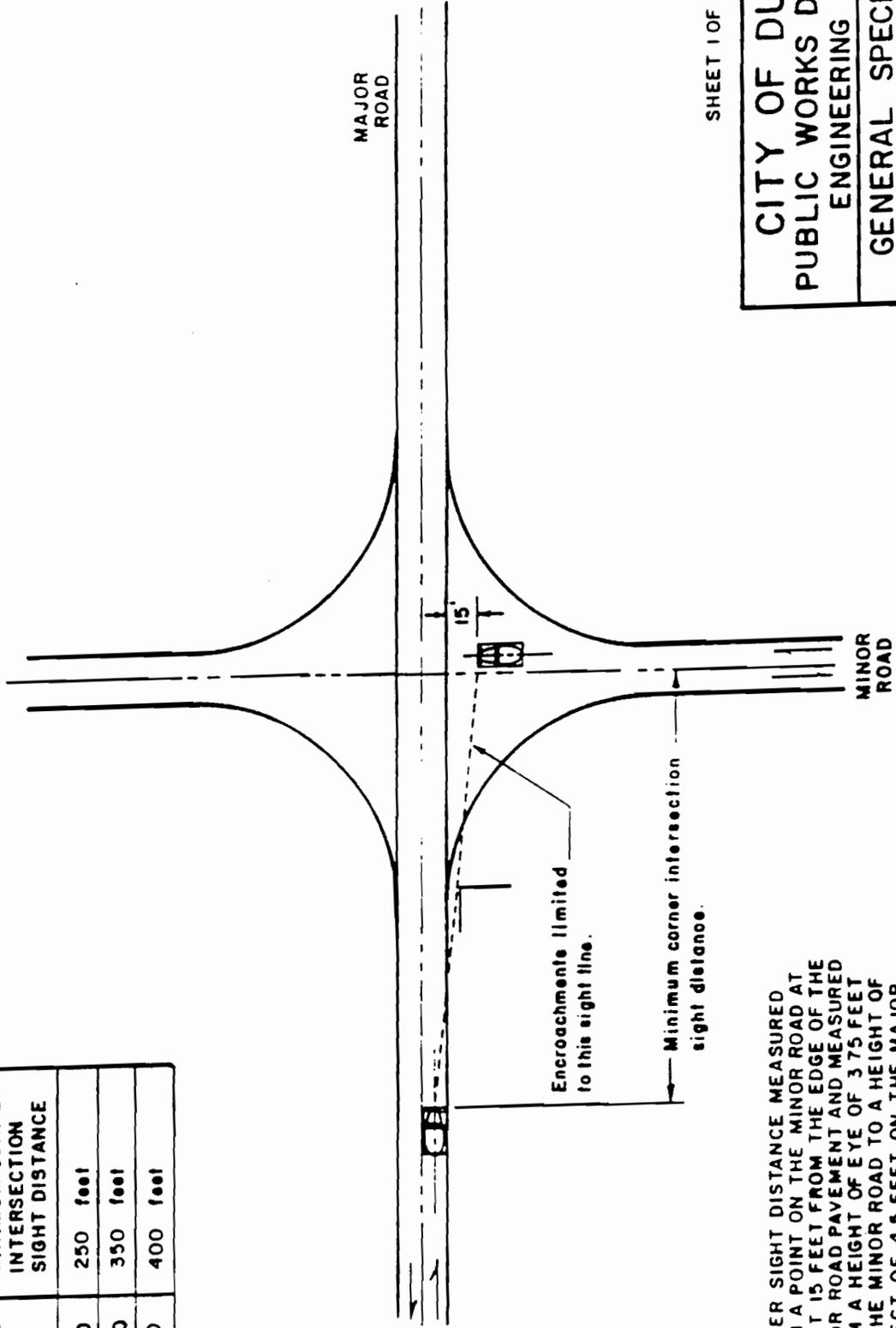
NOTES:

1. DIMENSION OF BASE VARIES WITH HOLE CUT IN SIDEWALK.
2. FORM WITH 2" x 6" AND 3/4" x 12" BOARDS TO ALLOW CONCRETE TO LAP DOWN INTO HOLE TO BOND TO SIDEWALK FOR STRENGTH.
3. PLACE 1/2" REBAR AROUND PERIMETER OF EXPOSED PLANTER.

CITY OF DURANGO	
PUBLIC WORKS DEPARTMENT	
ENGINEERING DIVISION	
GENERAL SPECIFICATIONS	
DWN. BY	A. G. W.
DATE	12-23-82
APPV. BY	
DWG. NO.	R-8

SIGHT DESIGN CRITERIA AT CORNERS

DESIGN SPEED M.P.H.	MINIMUM CORNER INTERSECTION SIGHT DISTANCE
25 - 30	250 feet
35 - 40	350 feet
45 - 50	400 feet



SHEET 1 OF 2

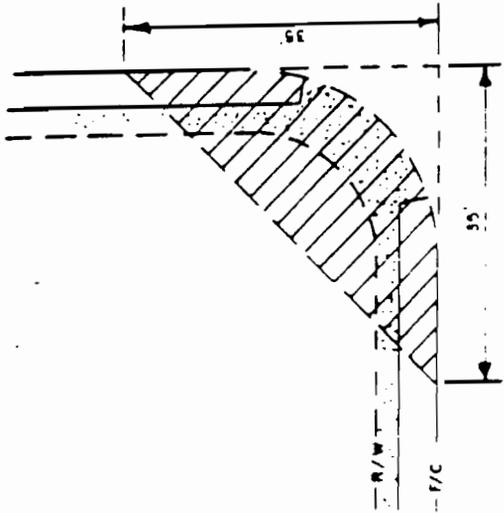
CITY OF DURANGO
PUBLIC WORKS DEPARTMENT
ENGINEERING DIVISION
GENERAL SPECIFICATIONS

DWN BY	A G W	DATE	12 - 28 - 82
APPV BY		DWG. NO.	R - 9

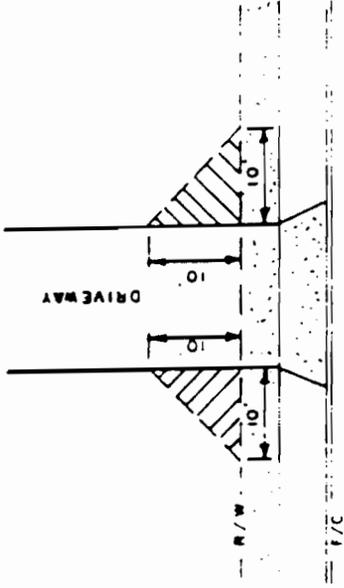
ALL PAVED ROAD INTERSECTIONS

CORNER SIGHT DISTANCE MEASURED FROM A POINT ON THE MINOR ROAD AT LEAST 15 FEET FROM THE EDGE OF THE MAJOR ROAD PAVEMENT AND MEASURED FROM A HEIGHT OF EYE OF 3.75 FEET ON THE MINOR ROAD TO A HEIGHT OF OBJECT OF 4.5 FEET ON THE MAJOR ROAD.

VISIBILITY REQUIREMENTS

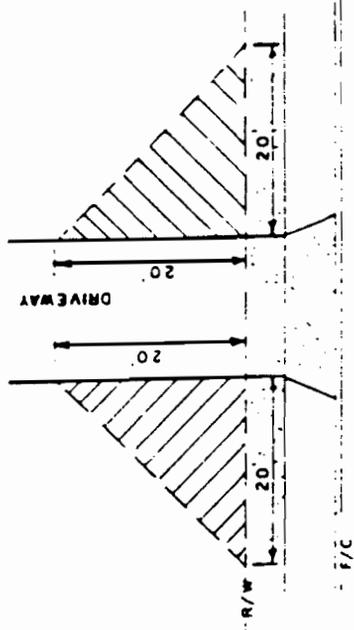


INTERSECTION



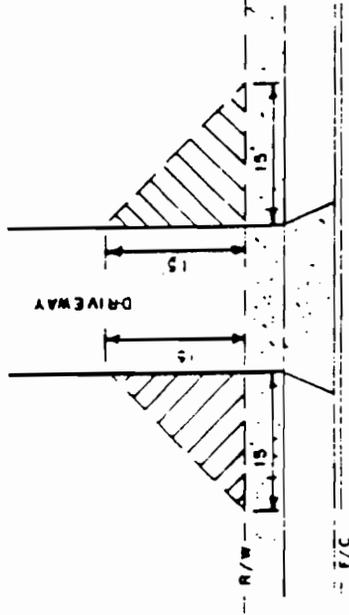
MINOR STREET
(LESS THAN 60' RIGHT OF WAY)

DRIVEWAY



MAJOR STREET
(GREATER THAN 60' RIGHT OF WAY)

DRIVEWAY



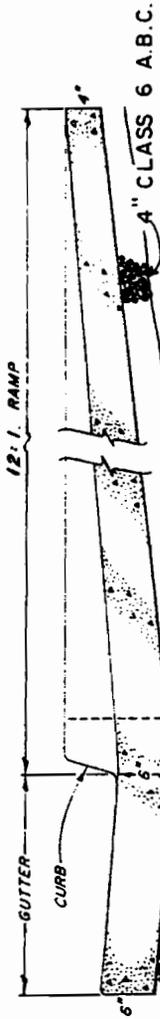
COLLECTOR STREET
(SIXTY FOOT RIGHT OF WAY)

DRIVEWAY

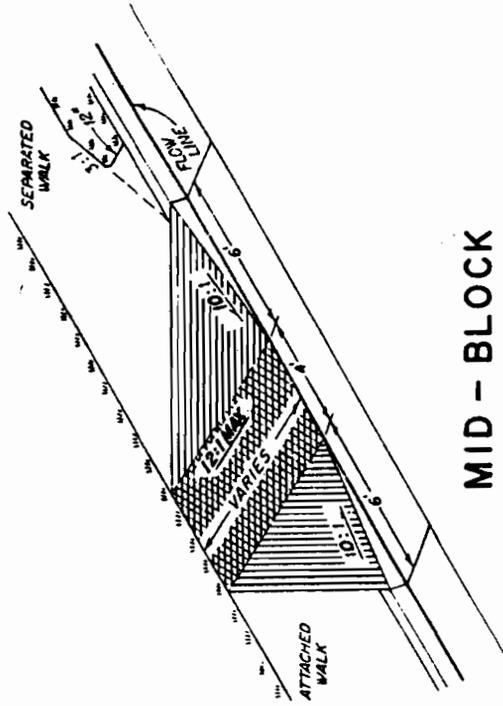
WITHIN CROSSHATCHED AREA ALL SHRUBS, BUSHES, FENCES, AND OTHER IMPROVEMENTS SHALL BE RESTRICTED TO A 2'-6" MAXIMUM HEIGHT AND TREES MAINTAINED TO A CLEARANCE OF 7'-0" ABOVE GROUND.

SHEET 2 OF 2

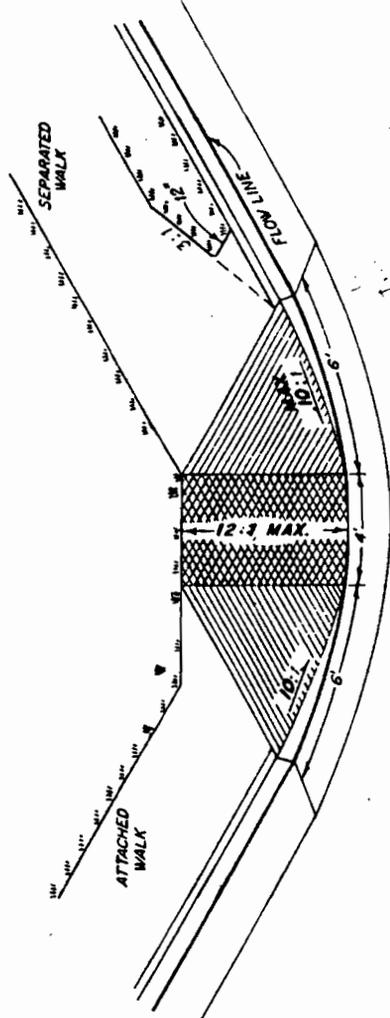
CITY OF DURANGO	
PUBLIC WORKS DEPARTMENT	
ENGINEERING DIVISION	
GENERAL SPECIFICATIONS	
OWN. BY R. L. B.	DATE 12-22-75
APPY. BY	DWG. NO R-9



TYPICAL RAMP SECTION



MID - BLOCK



CORNER

-  SHORT DIMENSION OF DIAMOND SHALL POINT TOWARD FLOW LINE.
-  RAMP SURFACES TEXTURED BY USING EXPANDED METAL MESH 3/16" DEEP TO MARK SURFACE.
-  WING SURFACES TEXTURED BY TILING GROOVES 1/4" WIDE x 3/16" DEEP AT 1/2" SPACING.
-  GRASS OR GRAVEL AREA ADJACENT TO RAMP, WING OR WALK THAT IS NOT APPROPRIATE FOR WHEELCHAIR TRAFFIC.

HANDICAP RAMPS

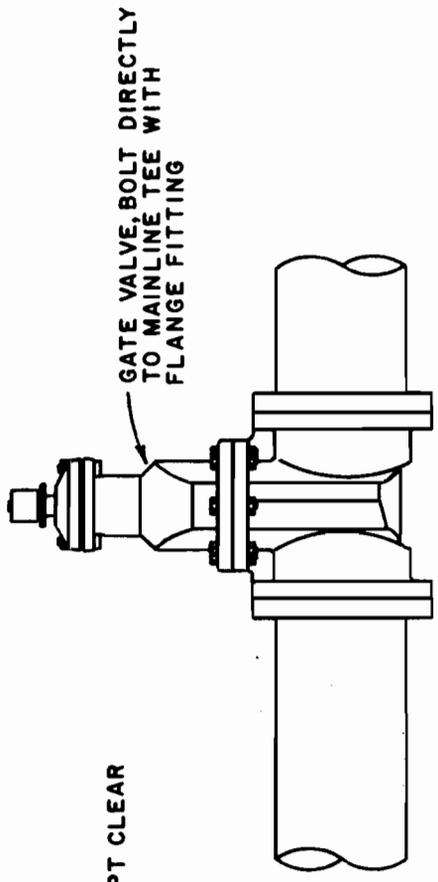
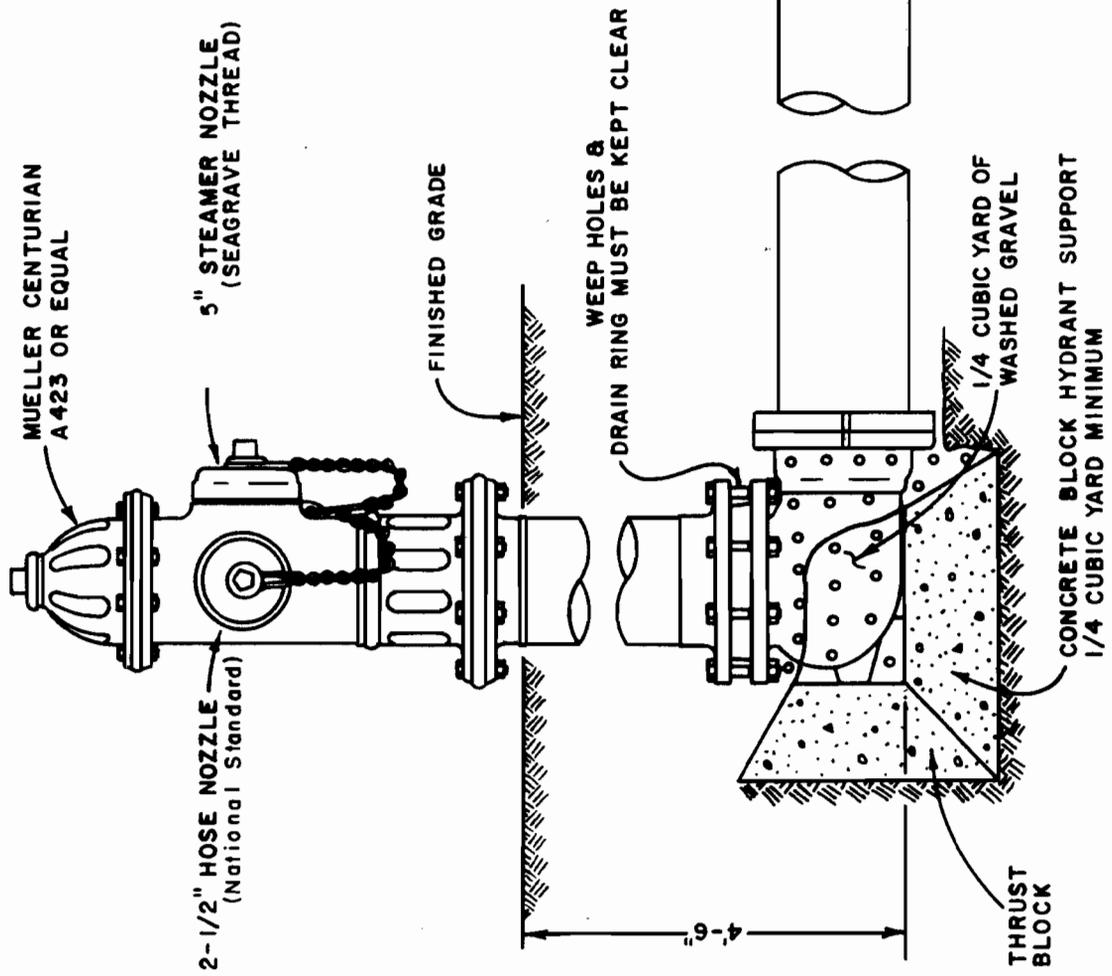
ADAPTED FROM C.D.O.H. STANDARD PLANS

REVISED 1/9/92 L.F.

CITY OF DURANGO
PUBLIC WORKS DEPARTMENT
ENGINEERING DIVISION

GENERAL SPECIFICATIONS

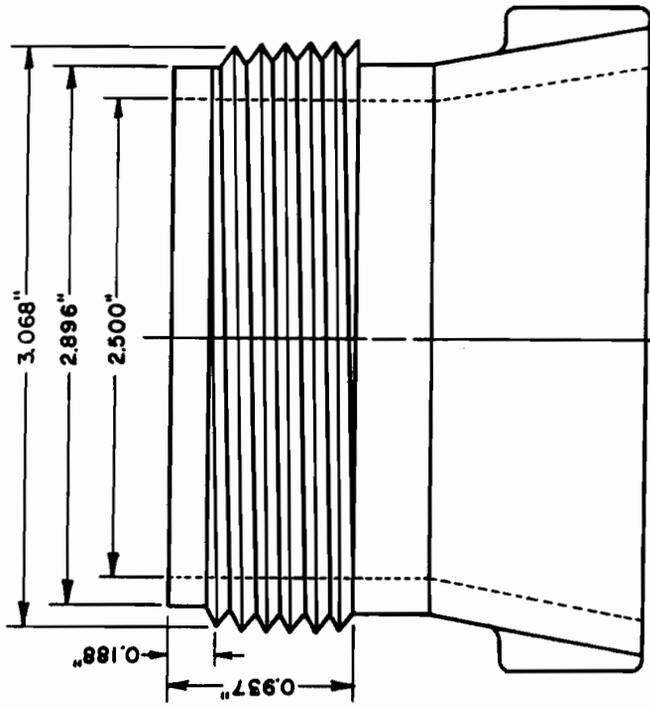
DWN. BY	D.F.	DATE	10 - 28 - 85
APPV. BY	O.J.R.	DWG. NO.	R-10



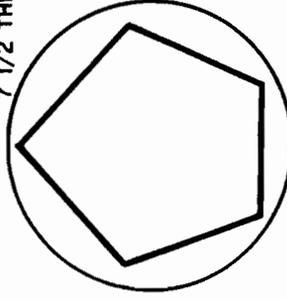
REVISED 7/88 LF

CITY OF DURANGO	
PUBLIC WORKS DEPARTMENT	
ENGINEERING DIVISION	
GENERAL SPECIFICATIONS	
DWN. BY	D.F.
DATE	11-30-83
APPV. BY	DWG. NO. W-1

STANDARD FIRE HYDRANT DETAIL

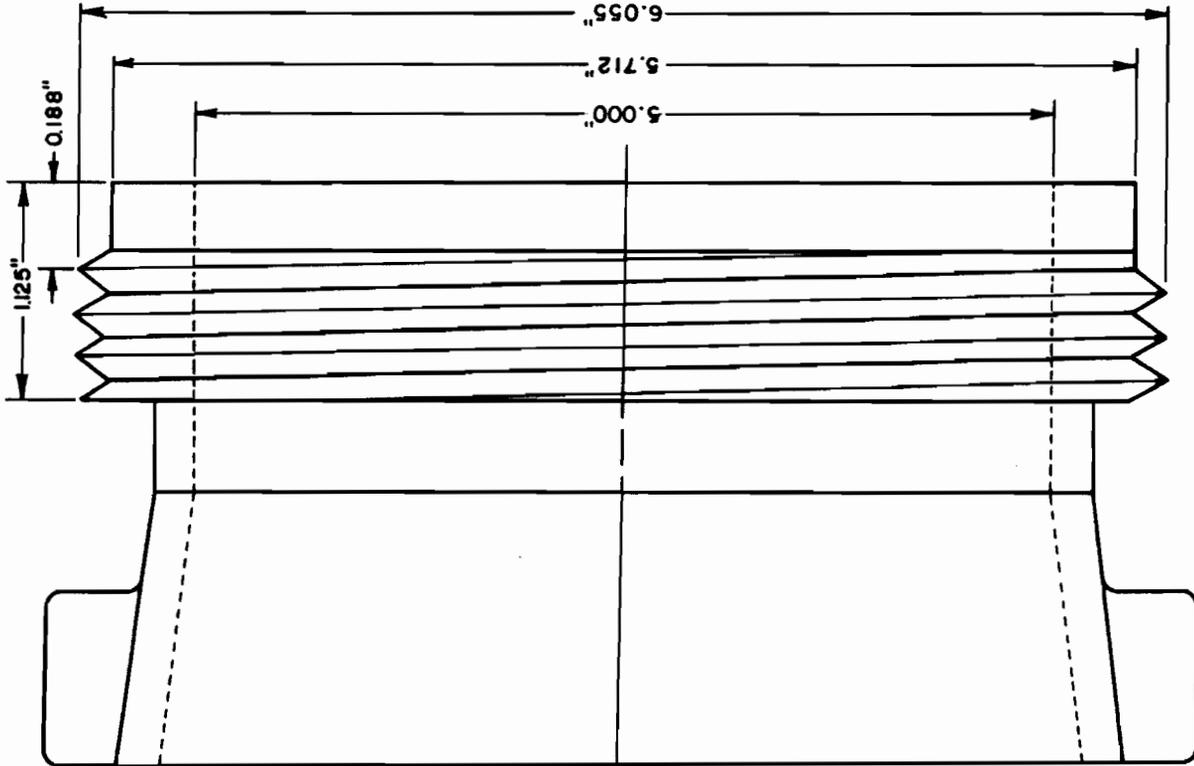


National Standard
2 1/2" HOSE NOZZLE
 7 1/2 THREADS/INCH



PENTAGON NUT

FIRE HYDRANT NOZZLE



5" STEAMER NOZZLE
 4 THREADS/INCH

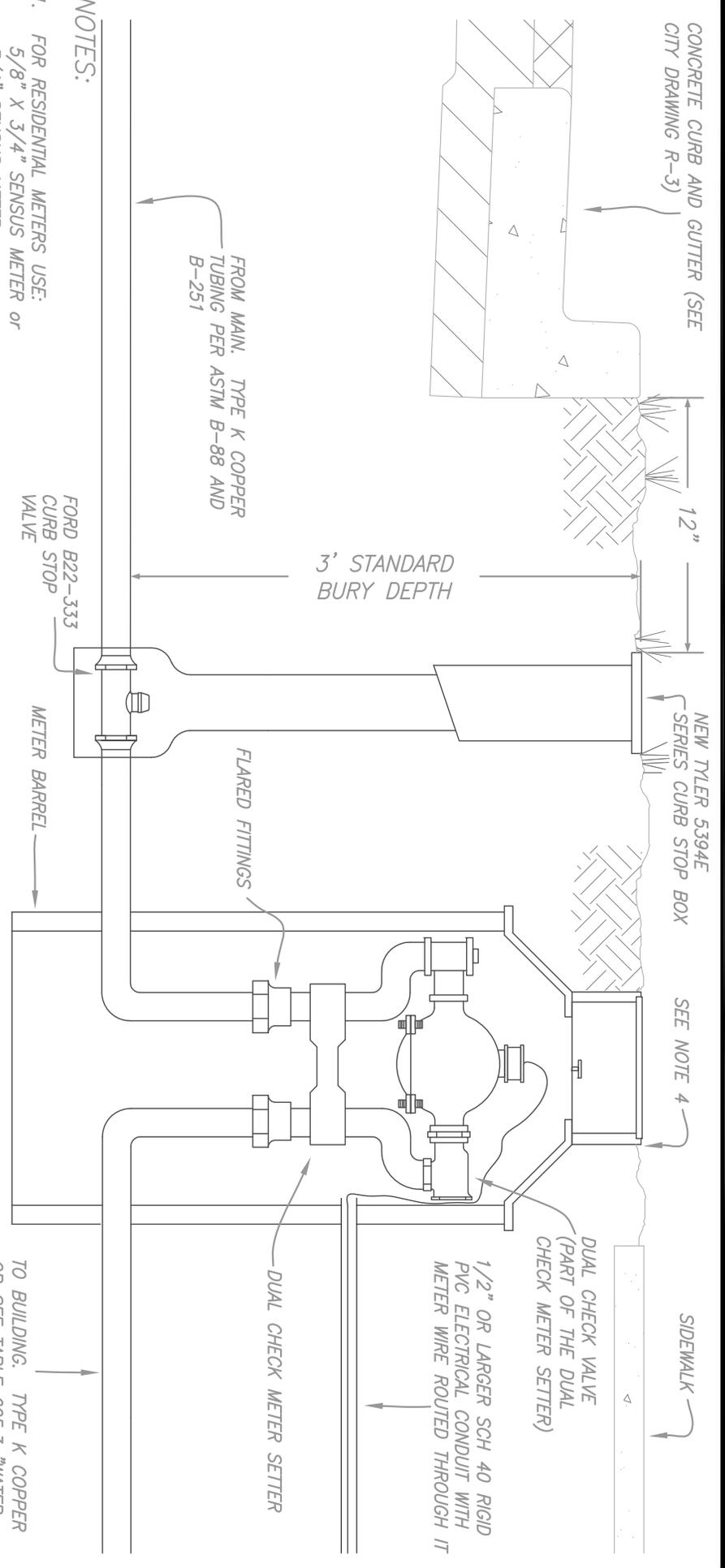
REVISED 7/88 LE

CITY OF DURANGO
PUBLIC WORKS DEPARTMENT
ENGINEERING DIVISION

GENERAL SPECIFICATIONS

DWN. BY J. S. DATE 9-6-78

APPV. BY DWG. NO. W-2



NOTES:

1. FOR RESIDENTIAL METERS USE:
 5/8" X 3/4" SENSUS METER or
 3/4" SENSUS METER or
 1" SENSUS METER
2. METER PIT BARREL, METER PIT COVER, METER PIT CONE, FROST PLATE, METER, DUAL CHECK METER SETTER, REMOTE READOUT OR RADIO, AND WIRE MUST BE PROCURED FROM THE CITY OF DURANGO WAREHOUSE, 105 SAWYER DR, DURANGO, CO.
3. CITY OF DURANGO PART INFORMATION:

PART	PART #
5/8" X 3/4" SENSUS ECR/WP METER or	4031502
3/4" SENSUS ECR/WP METER or	4031503
1" SENSUS ECR/WP METER	4031514
5/8" X 3/4" DUAL CHECK METER SETTER or	4681489
3/4" DUAL CHECK METER SETTER or	4684489
1" DUAL CHECK METER SETTER	4862244
M2 METER RADIO TRANSMITTER	4600002
PLASTIC METER BARREL	4002048
3 PIECE METER BARREL LID SET	4082290
3/4" FLARE CURB STOP VALVE	4022333
TYLER CURB STOP VALVE BOX	4053941

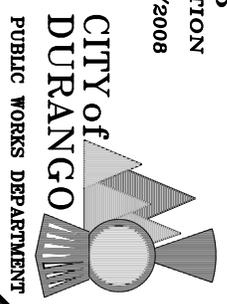
4. THE COVERS FOR THE METER PIT AND THE CURB STOP VALVE SHALL BE INSTALLED AND MAINTAINED LEVEL WITH THE ADJACENT FINISHED GRADE.

TO BUILDING. TYPE K COPPER
 OR SEE TABLE 605.3 "WATER
 SERVICE PIPE" IN CITY CODE
 CHAP. 6, ARTICLE V, SECTION
 6-67

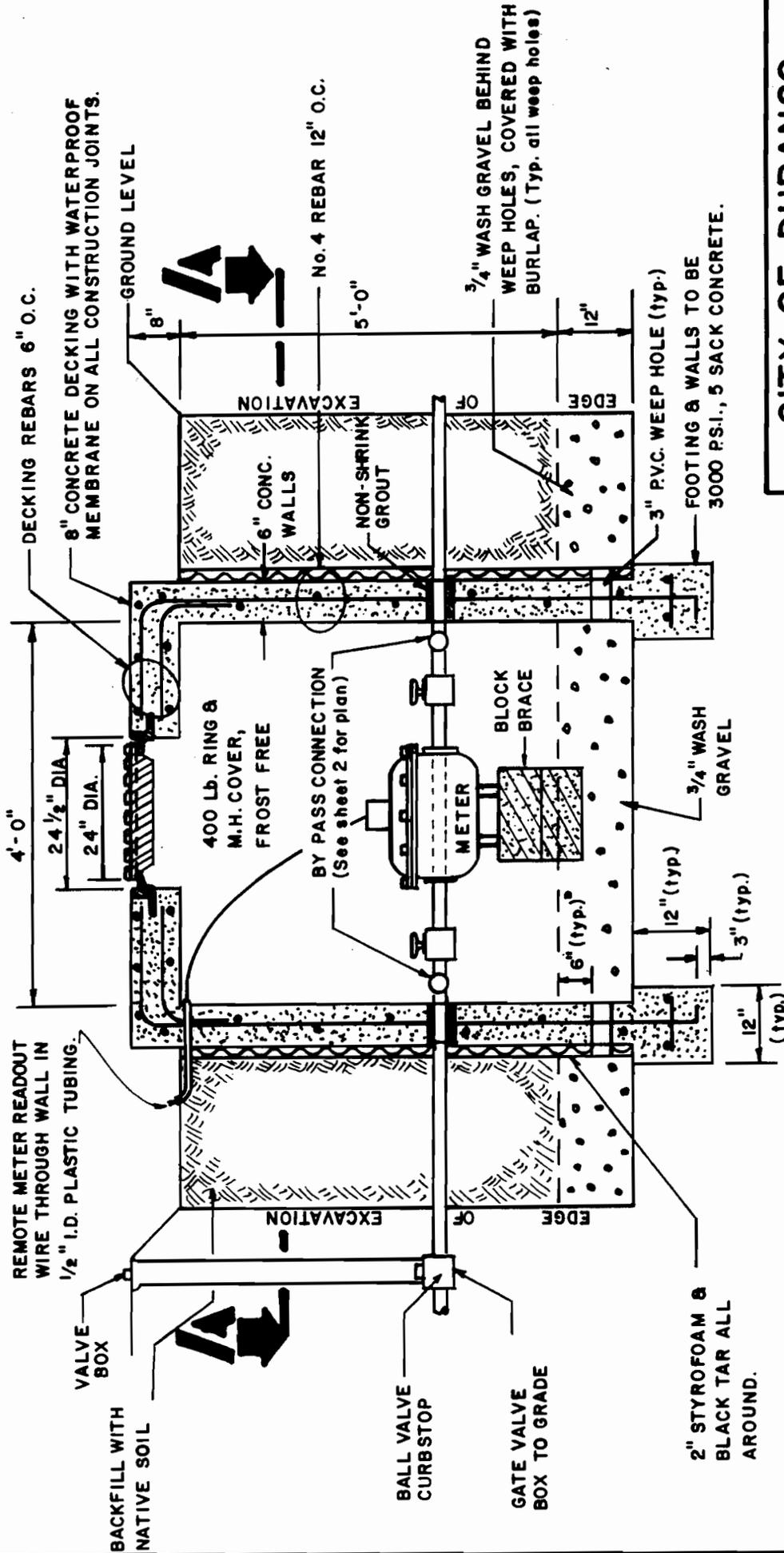
**General Specifications
 Drawing W-3**

WATER METER INSTALLATION
 1-Inch and Smaller
 Date: 08/26/2008

No.	Revision Description	Date:	By:
W-3	Major Revision for CCCP	10-06-2008	ALS
Drawn by: ALS			
Sheet No. 1 of 1			
Detail Drawing of Water Meter and Curb Stop Installation			



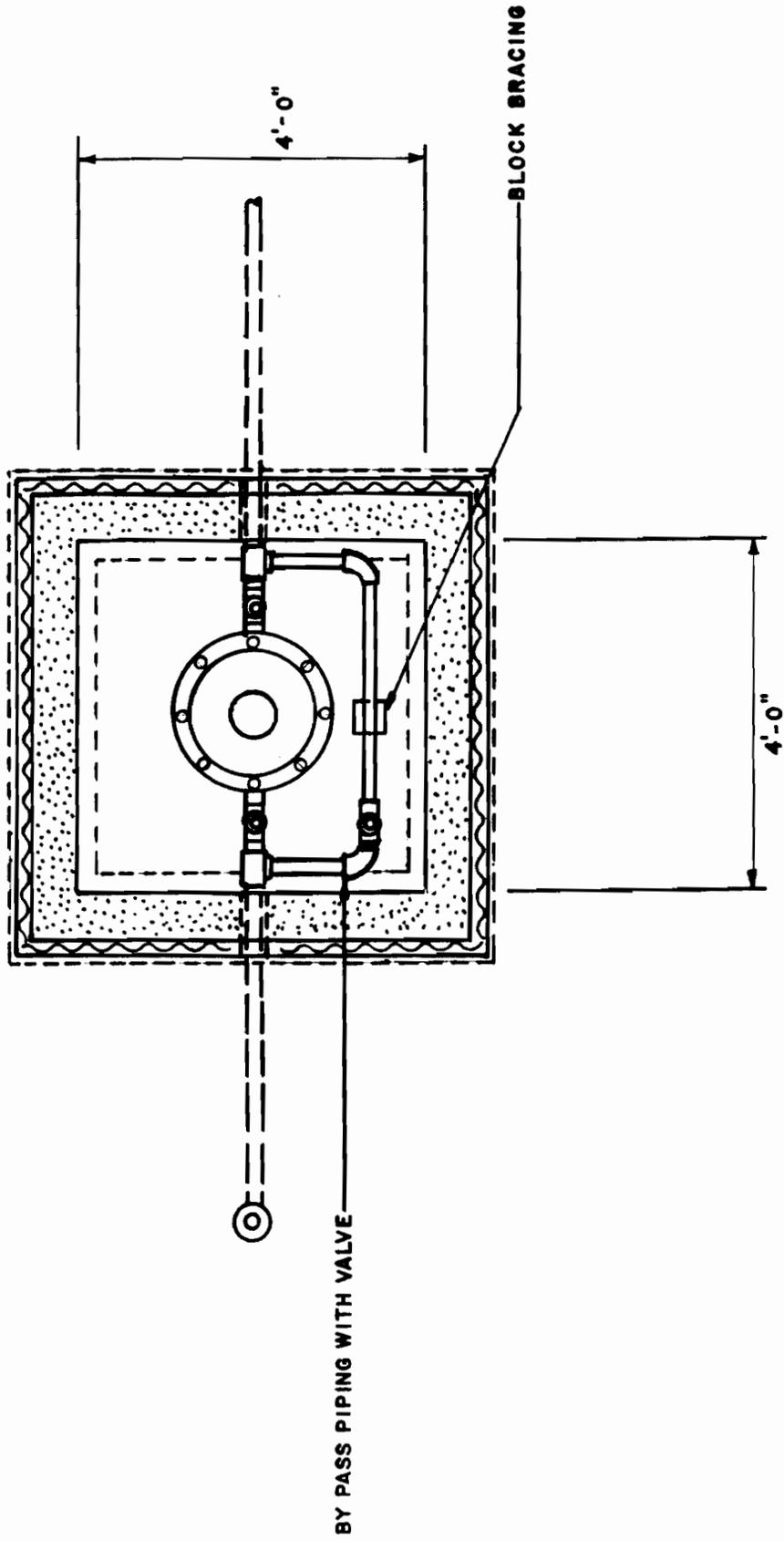
METER VAULT PIT

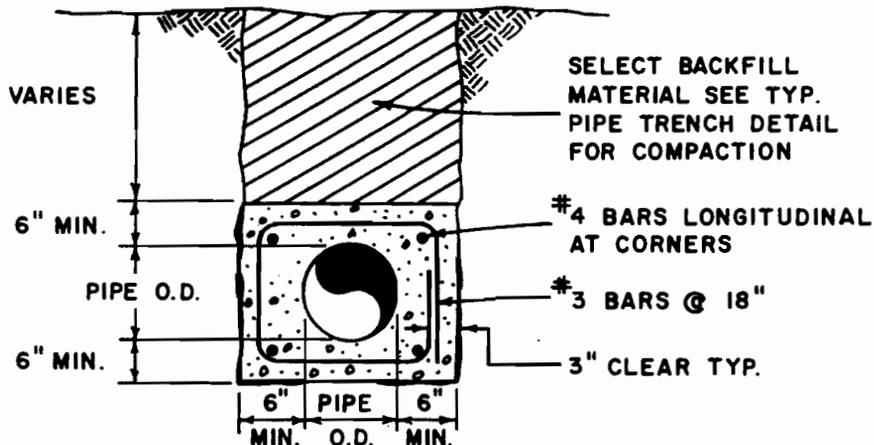


ELEVATION

CITY OF DURANGO PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION	
GENERAL SPECIFICATIONS	
DWN. BY	A.G.W.
DATE	12-21-82
APPV. BY	
DWG. NO.	W-4

**SECTION A-A
PLAN VIEW**





SELECT BACKFILL
MATERIAL SEE TYP.
PIPE TRENCH DETAIL
FOR COMPACTION

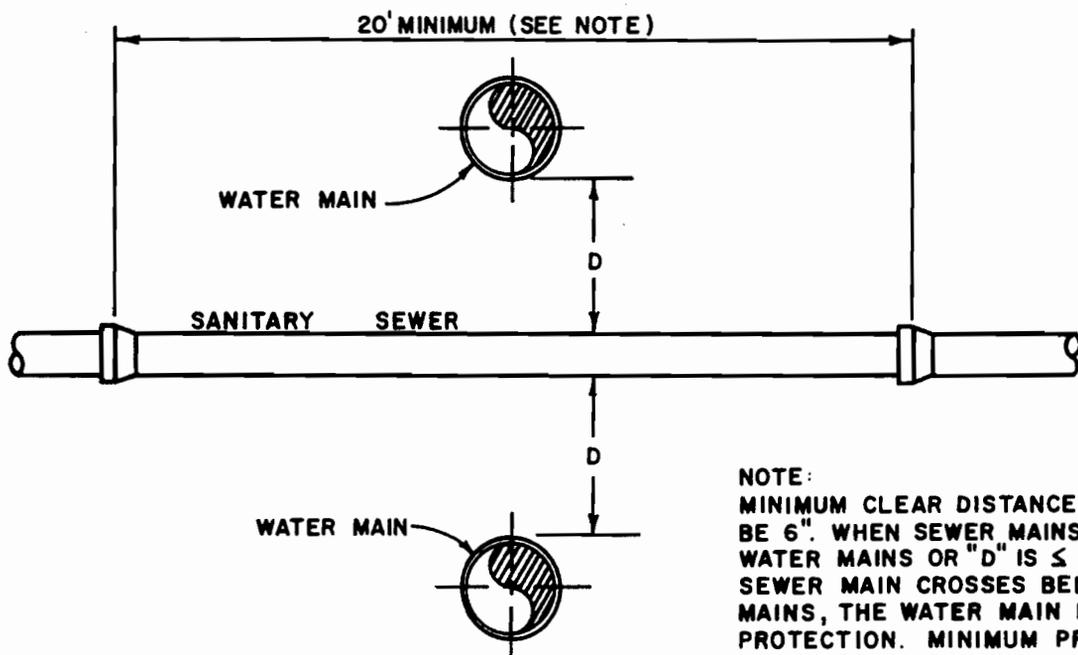
#4 BARS LONGITUDINAL
AT CORNERS

#3 BARS @ 18"

3" CLEAR TYP.

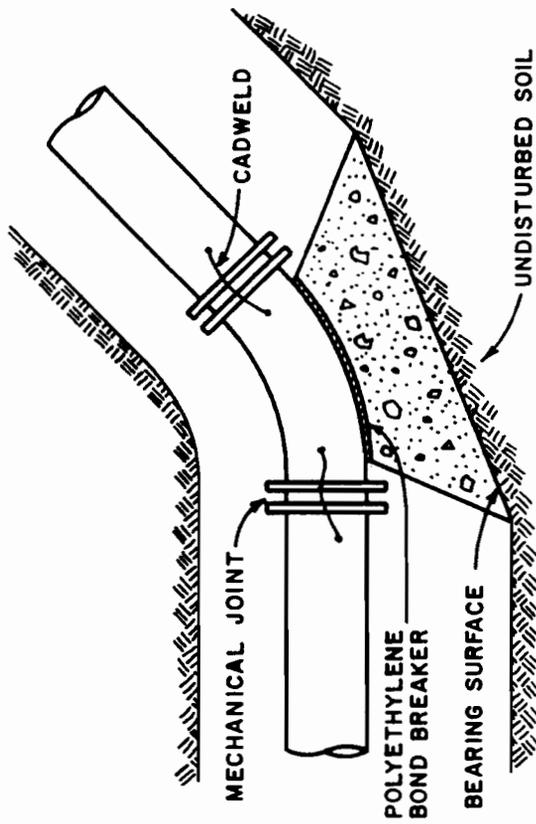
CONCRETE ENCASEMENT

CITY OF DURANGO PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION		DATE	11-30-83
		DWG. NO.	W-5
DWN. BY	D.F.		
APPV. BY			

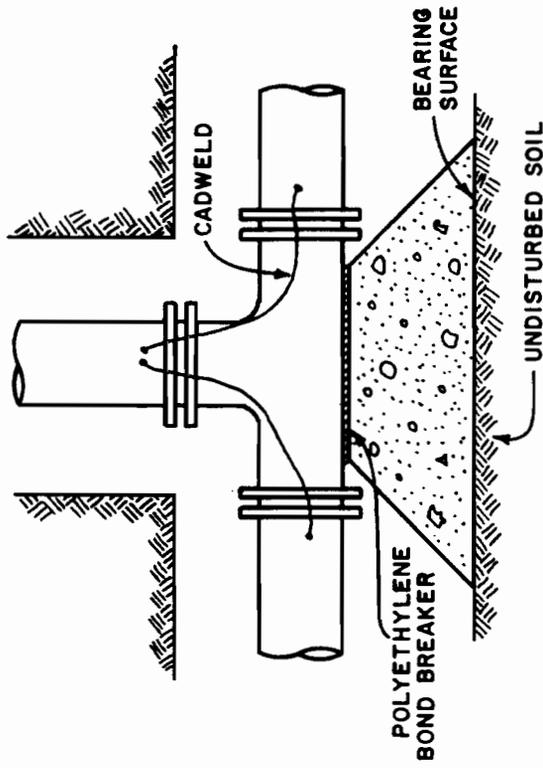


NOTE:
MINIMUM CLEAR DISTANCE FOR "D" MUST
BE 6". WHEN SEWER MAINS CROSS ABOVE
WATER MAINS OR "D" IS ≤ 18" WHEN
SEWER MAIN CROSSES BELOW WATER
MAIN, THE WATER MAIN MUST HAVE
PROTECTION. MINIMUM PROTECTION
SHALL BE AN IMPERVIOUS STRUCTURAL
SEWER FOR A DISTANCE OF 10' EACH
SIDE OF THE WATER MAIN.

SANITARY SEWER - WATER MAIN CROSSING



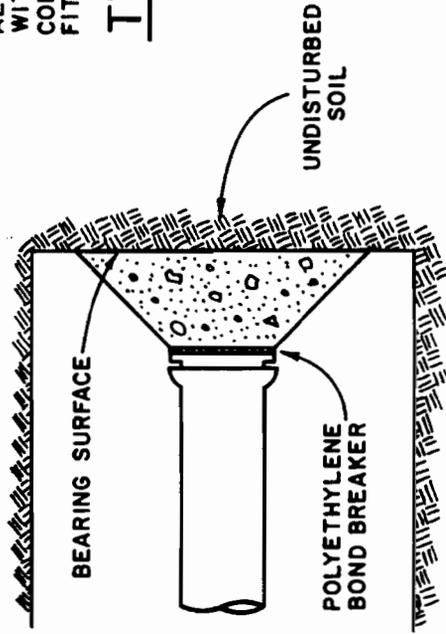
11-1/4°, 22-1/2°, 45°, 90° BENDS



TEE

ALL FITTINGS REQUIRING THRUST BLOCKS SHALL BE WRAPPED WITH POLYETHYLENE ENCASMENT MATERIAL. CONCRETE SHALL NOT BEAR ON BOLTS OF MECHANICAL JOINT FITTINGS.

TYPICAL THRUST BLOCK DETAILS



DEAD END

CITY OF DURANGO PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION	
GENERAL SPECIFICATIONS	
DWN. BY D.F.	DATE 11-30-83
APPV. BY	DWG. NO. W-6

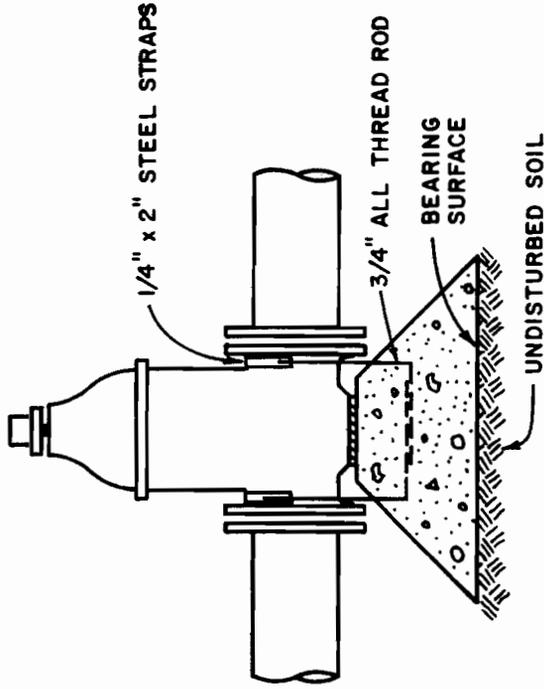
TABLE FOR CONCRETE THRUST BLOCKING BEARING AREAS (IN SQ. FT.)

SIZE	BENDS			TEES, DEAD ENDS, AND CROSS W DEAD END BRANCHES
	90°	45°	22-1/2°	
3	1.0	0.6	0.3	0.7
4	1.8	1.0	0.5	1.3
6	4.0	2.2	1.1	2.8
8	7.1	3.8	2.0	5.0
10	11.1	6.0	3.0	7.8
12	16.0	8.6	4.4	11.3
14	21.7	11.8	6.0	15.4
15	25.0	13.5	7.0	17.6
16	28.4	15.3	8.0	20.0
18	36.0	19.4	10.0	25.4
20	44.2	24.0	12.2	31.4
21	49.0	26.5	13.5	34.6
22	54.0	29.0	14.8	38.0
24	64.0	34.5	17.7	45.0
30	100.0	54.0	27.6	71.0
36	144.0	78.0	40.0	102.0

NOTE: TEE SIZE IS BRANCH SIZE.

AREAS GIVEN IN TABLE ARE BASED UPON INTERNAL STATIC PRESSURE OF 100 P.S.I. AND A SOIL BEARING CAPACITY OF 1,000 lbs. PER SQUARE FOOT. BEARING AREAS FOR ANY PRESSURE AND SOIL BEARING CAPACITY MAY BE OBTAINED BY MULTIPLYING TABULATED VALUES BY A CORRECTION FACTOR "F".

F = ACTUAL SPECIFIED TEST PRESSURE IN HUNDREDS OF lbs. / ACTUAL SOIL BEARING CAPACITY IN THOUSANDS OF lbs.



VALVES

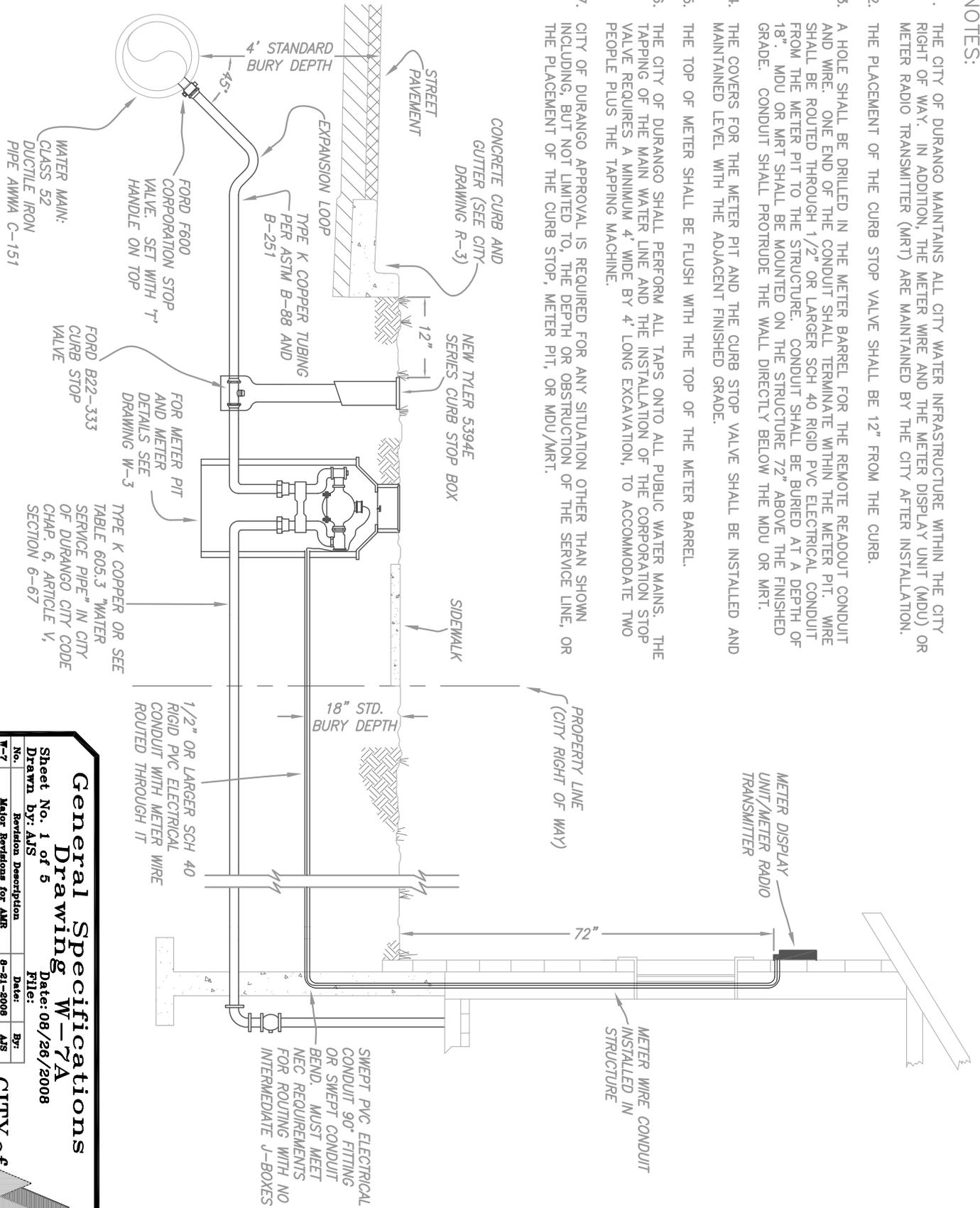
THRUST BLOCK DETAILS

ALL FITTINGS REQUIRING THRUST BLOCKS SHALL BE WRAPPED WITH POLYETHYLENE ENCASUREMENT MATERIAL. SOIL BEARING CAPACITIES SHALL BE DETERMINED BY THE ENGINEER.

CITY OF DURANGO PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION	
GENERAL SPECIFICATIONS	
DWN. BY	D.F.
DATE	11-30-83
APPV. BY	
DWG. NO.	W-6

NOTES:

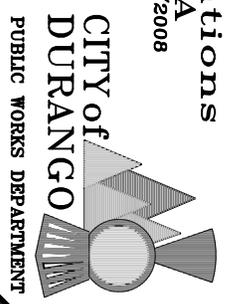
1. THE CITY OF DURANGO MAINTAINS ALL CITY WATER INFRASTRUCTURE WITHIN THE CITY RIGHT OF WAY. IN ADDITION, THE METER WIRE AND THE METER DISPLAY UNIT (MDU) OR METER RADIO TRANSMITTER (MRT) ARE MAINTAINED BY THE CITY AFTER INSTALLATION.
2. THE PLACEMENT OF THE CURB STOP VALVE SHALL BE 12" FROM THE CURB.
3. A HOLE SHALL BE DRILLED IN THE METER BARREL FOR THE REMOTE READOUT CONDUIT AND WIRE. ONE END OF THE CONDUIT SHALL TERMINATE WITHIN THE METER PIT. WIRE SHALL BE ROUTED THROUGH 1/2" OR LARGER SCH 40 RIGID PVC ELECTRICAL CONDUIT FROM THE METER PIT TO THE STRUCTURE. CONDUIT SHALL BE BURIED AT A DEPTH OF 18". MDU OR MRT SHALL BE MOUNTED ON THE STRUCTURE 72" ABOVE THE FINISHED GRADE. CONDUIT SHALL PROTRUDE THE WALL DIRECTLY BELOW THE MDU OR MRT.
4. THE COVERS FOR THE METER PIT AND THE CURB STOP VALVE SHALL BE INSTALLED AND MAINTAINED LEVEL WITH THE ADJACENT FINISHED GRADE.
5. THE TOP OF METER SHALL BE FLUSH WITH THE TOP OF THE METER BARREL.
6. THE CITY OF DURANGO SHALL PERFORM ALL TAPS ONTO ALL PUBLIC WATER MAINS. THE TAPPING OF THE MAIN WATER LINE AND THE INSTALLATION OF THE CORPORATION STOP VALVE REQUIRES A MINIMUM 4' WIDE BY 4' LONG EXCAVATION, TO ACCOMMODATE TWO PEOPLE PLUS THE TAPPING MACHINE.
7. CITY OF DURANGO APPROVAL IS REQUIRED FOR ANY SITUATION OTHER THAN SHOWN INCLUDING, BUT NOT LIMITED TO, THE DEPTH OR OBSTRUCTION OF THE SERVICE LINE, OR THE PLACEMENT OF THE CURB STOP, METER PIT, OR MDU/MRT.

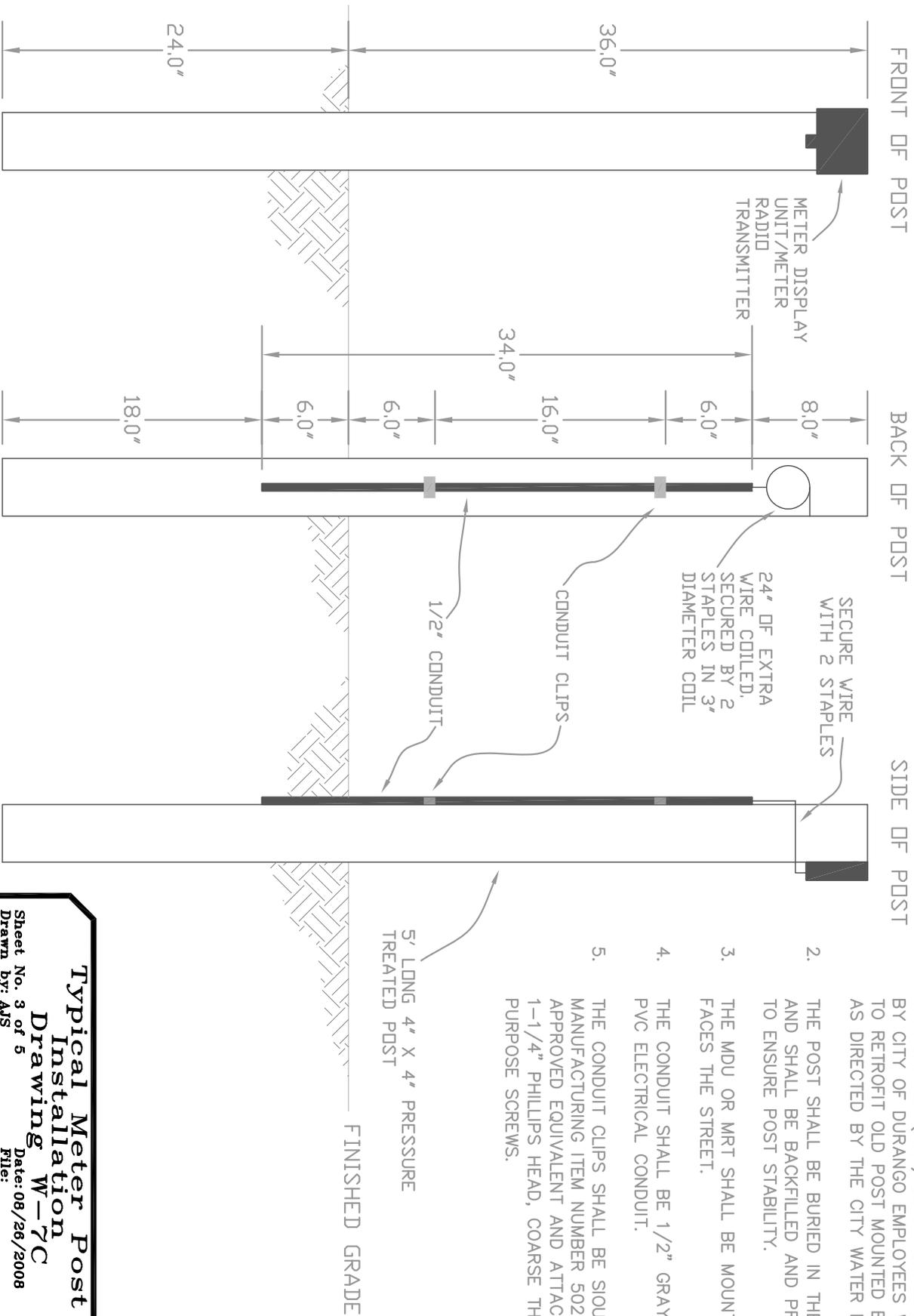


**General Specifications
Drawing W-7A**

Sheet No. 1 of 5
 Date: 08/26/2008
 Drawn by: AJS
 Major Revisions for AWR

No.	Revision Description	Date:	By:
W-7	Major Revisions for AWR	8-21-2008	AJS





NOTES:

1. THIS METER DISPLAY UNIT (MDU) OR METER RADIO TRANSMITTER (MRT) SETUP SHALL BE USED ONLY BY CITY OF DURANGO EMPLOYEES WHEN DIRECTED TO RETROFIT OLD POST MOUNTED EQUIPMENT OR AS DIRECTED BY THE CITY WATER MANAGER.
2. THE POST SHALL BE BURIED IN THE GROUND 24" AND SHALL BE BACKFILLED AND PROPERLY TAMPED TO ENSURE POST STABILITY.
3. THE MDU OR MRT SHALL BE MOUNTED SO THAT IT FACES THE STREET.
4. THE CONDUIT SHALL BE 1/2" GRAY SCH40 RIGID PVC ELECTRICAL CONDUIT.
5. THE CONDUIT CLIPS SHALL BE SIOUX CHIEF MANUFACTURING ITEM NUMBER 502-2PK2 OR APPROVED EQUIVALENT AND ATTACHED WITH TWO 1-1/4" PHILLIPS HEAD, COARSE THREAD ALL PURPOSE SCREWS.

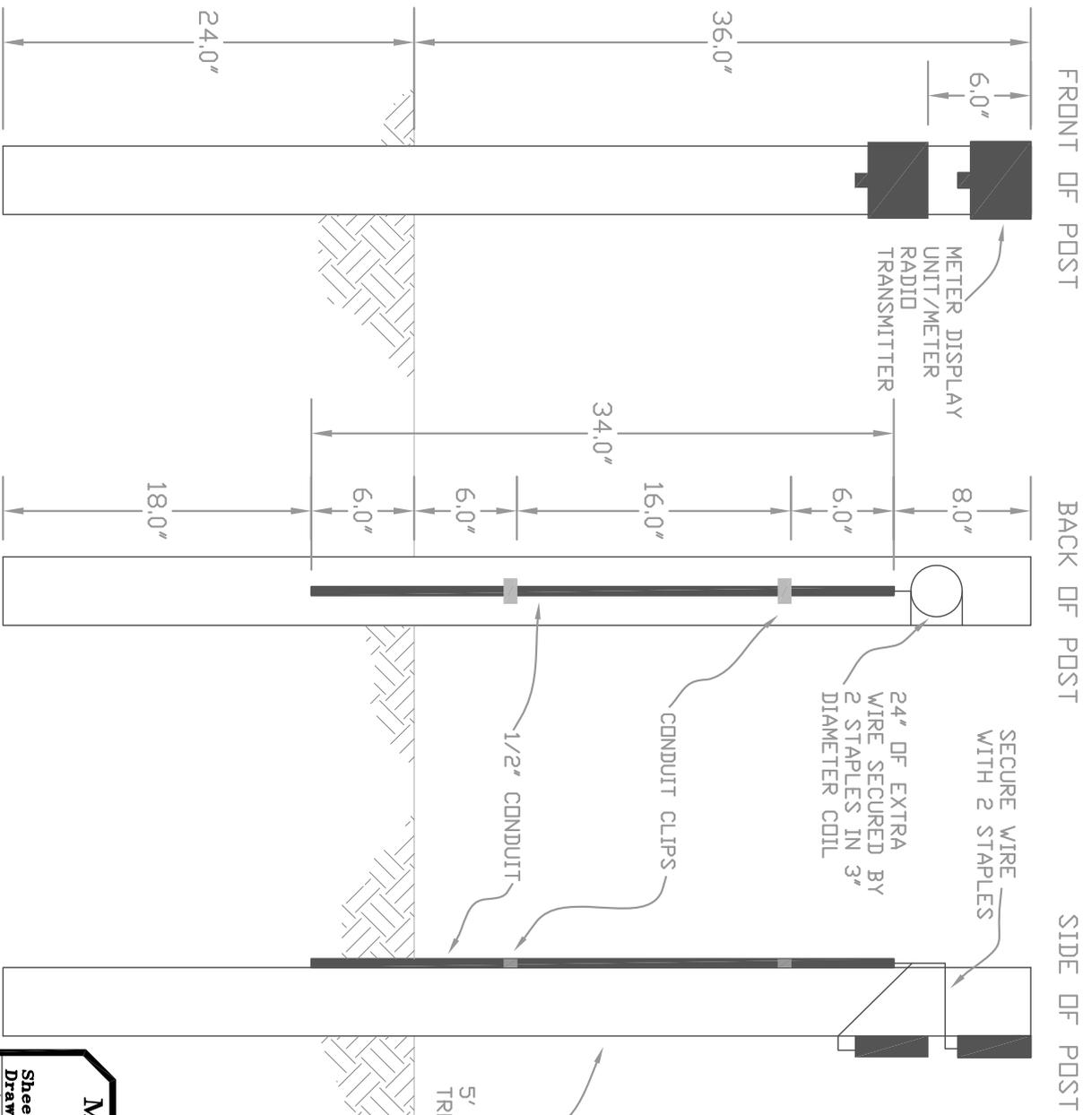
**Typical Meter Post
Installation
Drawing W-7C**

Sheet No. 3 of 5
Date: 08/26/2008

Drawn by: AJS
File:

No.	Revision Description	Date:	By:
	New Detail Drawing for AWR	8-21-2008	AJS





NOTES:

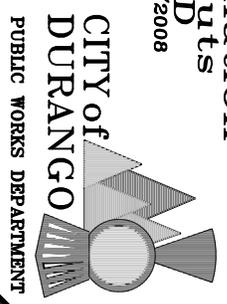
1. THIS METER DISPLAY UNIT (MDU) OR METER RADIO TRANSMITTER (MRT) SETUP SHALL BE USED ONLY BY CITY OF DURANGO EMPLOYEES WHEN DIRECTED TO RETROFIT OLD POST MOUNTED EQUIPMENT OR AS DIRECTED BY THE CITY WATER MANAGER.
2. THE POST SHALL BE BURIED IN THE GROUND 24" AND SHALL BE BACKFILLED AND PROPERLY TAMPED TO ENSURE POST STABILITY. THE MINIMUM HEIGHT FROM THE GROUND TO THE TOP OF THE LOWEST MDU OR MRT SHALL BE NO LESS THEN 30".
3. THE MDU OR MRT SHALL BE MOUNTED SO THAT IT FACES THE STREET.
4. THE CONDUIT SHALL BE 1/2" GRAY SCHA40 RIGID PVC ELECTRICAL CONDUIT.
5. THE CONDUIT CLIPS SHALL BE SIOUX CHIEF MANUFACTURING ITEM NUMBER 502-2PK2 OR APPROVED EQUIVALENT AND ATTACHED WITH TWO 1-1/4" PHILLIPS HEAD, COARSE THREAD ALL PURPOSE SCREWS.

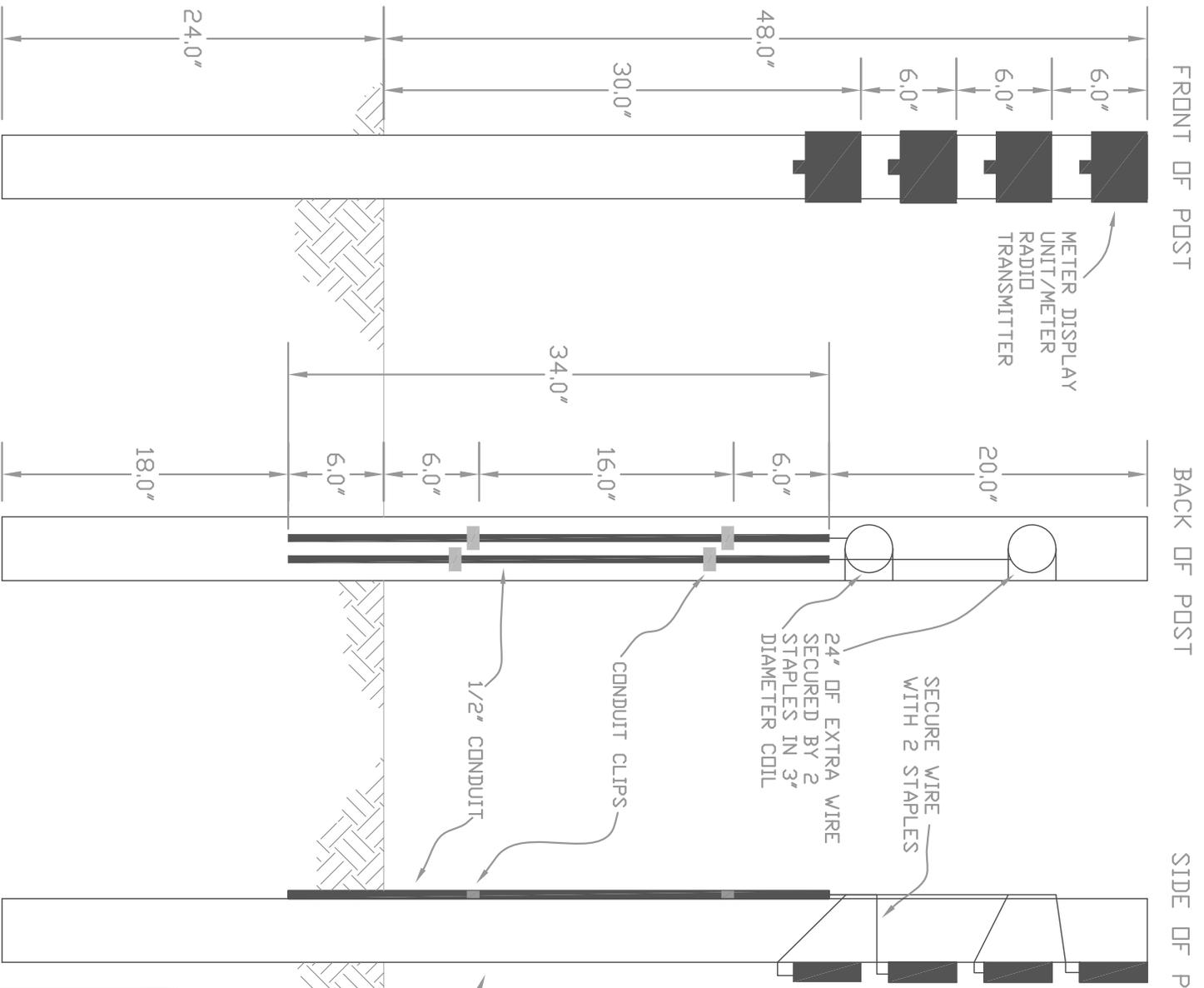
5' LONG 4" X 4" PRESSURE TREATED POST
FINISHED GRADE

**Meter Post Installation
for Two Readouts
Drawing W-7D**

Sheet No. 4 of 5
Date: 08/26/2008

No.	Revision Description	Date:	By:
1	New Detail Drawing for AWR	8-21-2008	AJS





NOTES:

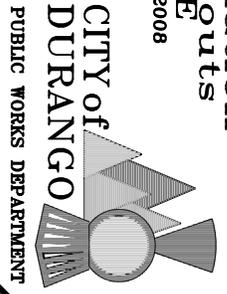
1. THIS METER DISPLAY UNIT (MDU) OR METER RADIO TRANSMITTER (MRT) SETUP SHALL BE USED ONLY BY CITY OF DURANGO EMPLOYEES WHEN DIRECTED TO RETROFIT OLD POST MOUNTED EQUIPMENT OR AS DIRECTED BY THE CITY WATER MANAGER.
2. THIS REMOTE READOUT SETUP SHALL BE USED FOR THREE AND FOUR MDU OR MRT SETUPS.
3. THE POST SHALL BE BURIED IN THE GROUND 24" AND SHALL BE BACKFILLED AND PROPERLY TAMPED TO INSURE POST STABILITY. THE MINIMUM HEIGHT FROM THE GROUND TO THE TOP OF THE LOWEST READOUT SHALL BE NO LESS THEN 30".
4. THE MDU OR MRT SHALL BE MOUNTED SO THAT IT FACES THE STREET.
5. THE CONDUIT SHALL BE 1/2" GRAY SCH40 RIGID PVC GRAY OR APPROVED EQUIVALENT.
6. THE CONDUIT CLIPS SHALL BE SIOUX CHIEF MANUFACTURING ITEM NUMBER 502-2PK2 AND ATTACHED WITH TWO 1-1/4" PHILLIPS HEAD, COARSE THREAD ALL PURPOSE SCREWS.

6' LONG 4" X 4" PRESSURE TREATED POST
FINISHED GRADE

**Meter Post Installation
for 3 or 4 Readouts
Drawing W-7E**

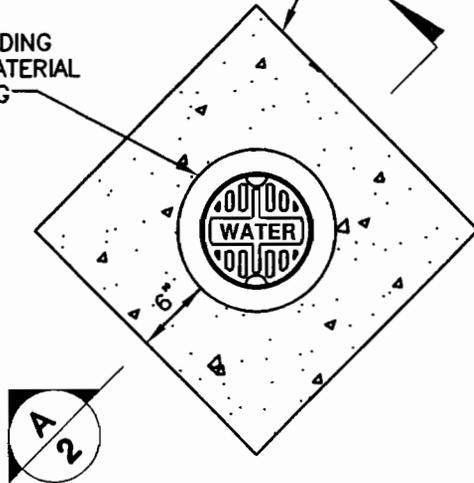
Sheet No. 5 of 5
Date: 08/26/2008

No.	Revision Description	Date:	By:
1	New Detail Drawing for AWR	8-21-2008	AJS



BOND BREAKER
PLASTIC SHEET, BUILDING
PAPER OR OTHER MATERIAL
TO PREVENT BONDING

6-INCH THICK CONCRETE COLLAR
CONCRETE SHALL BE 4000 psi
5 1/2 SACK MIX, MINIMUM



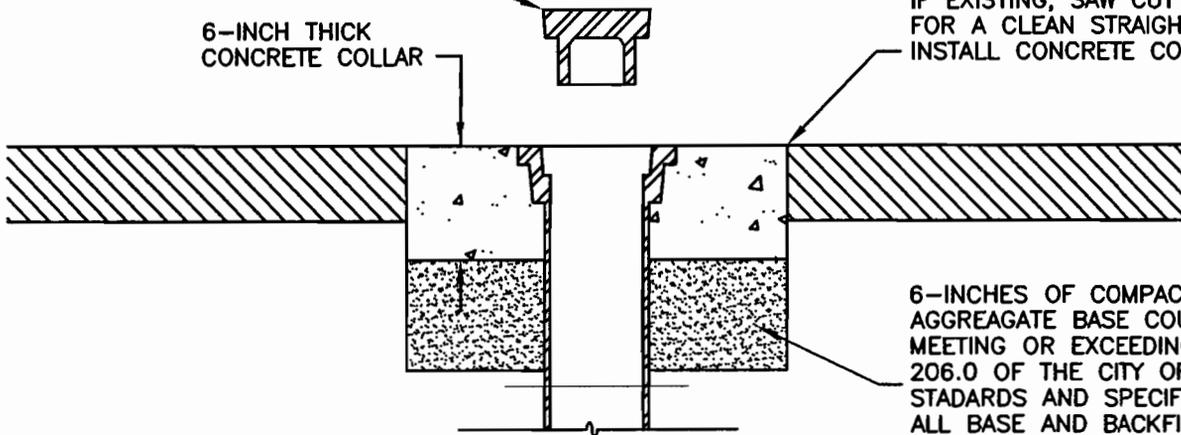
DIRECTION OF
TRAFFIC MOVEMENT

PLAN VIEW

5-1/4" MWW SERIES
ADJUSTABLE CAST IRON
RISER AND DROP LID
MARKED "WATER"

6-INCH THICK
CONCRETE COLLAR

NEW OR EXISTING PAVEMENT.
IF EXISTING, SAW CUT PAVEMENT
FOR A CLEAN STRAIGHT EDGE TO
INSTALL CONCRETE COLLAR.



6-INCHES OF COMPACTED CLASS 6
AGGREGATE BASE COURSE
MEETING OR EXCEEDING SECTION
206.0 OF THE CITY OF DURANGO
STADARDS AND SPECIFICATIONS.
ALL BASE AND BACKFILL MATERIAL
SHALL BE COMPACTED TO 95%
DENSITY IN ACCORDANCE WITH
AASHTO T180 AT ± 2% OPTIMUM
MOISTURE.

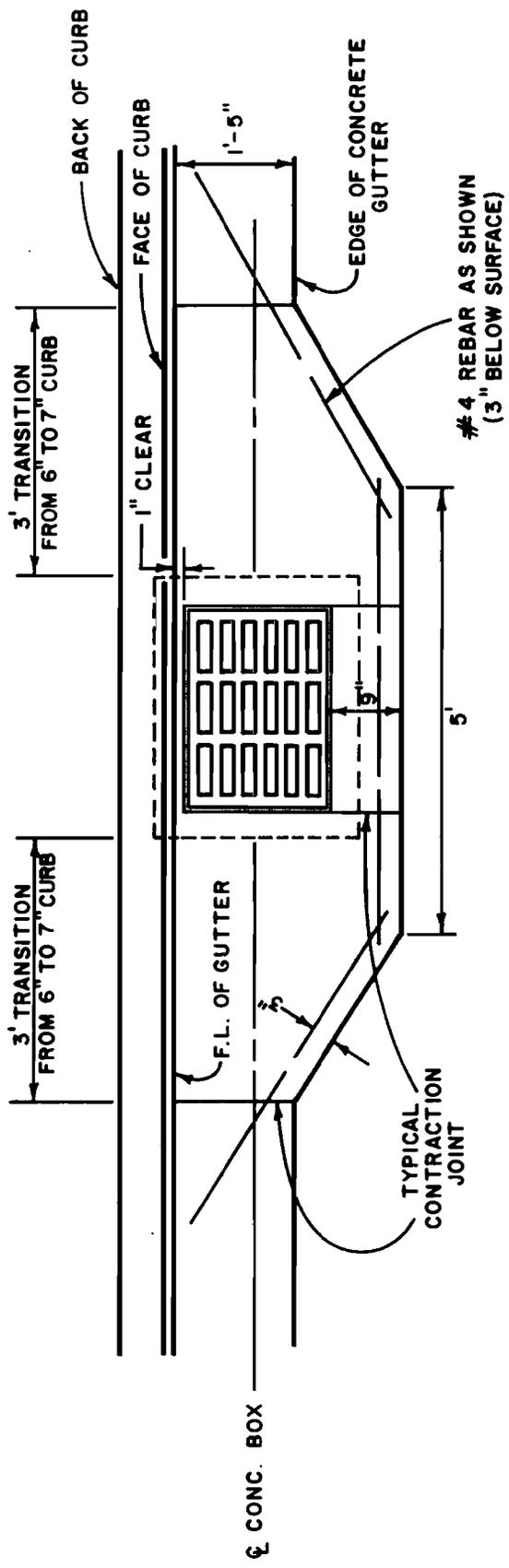
SECTION A-A
NTS

SECTION A

WATER
VALVE
CONCRETE MANHOLE COLLAR DETAIL

NTS

W-8



STORM DRAIN DETAILS

GENERAL NOTES

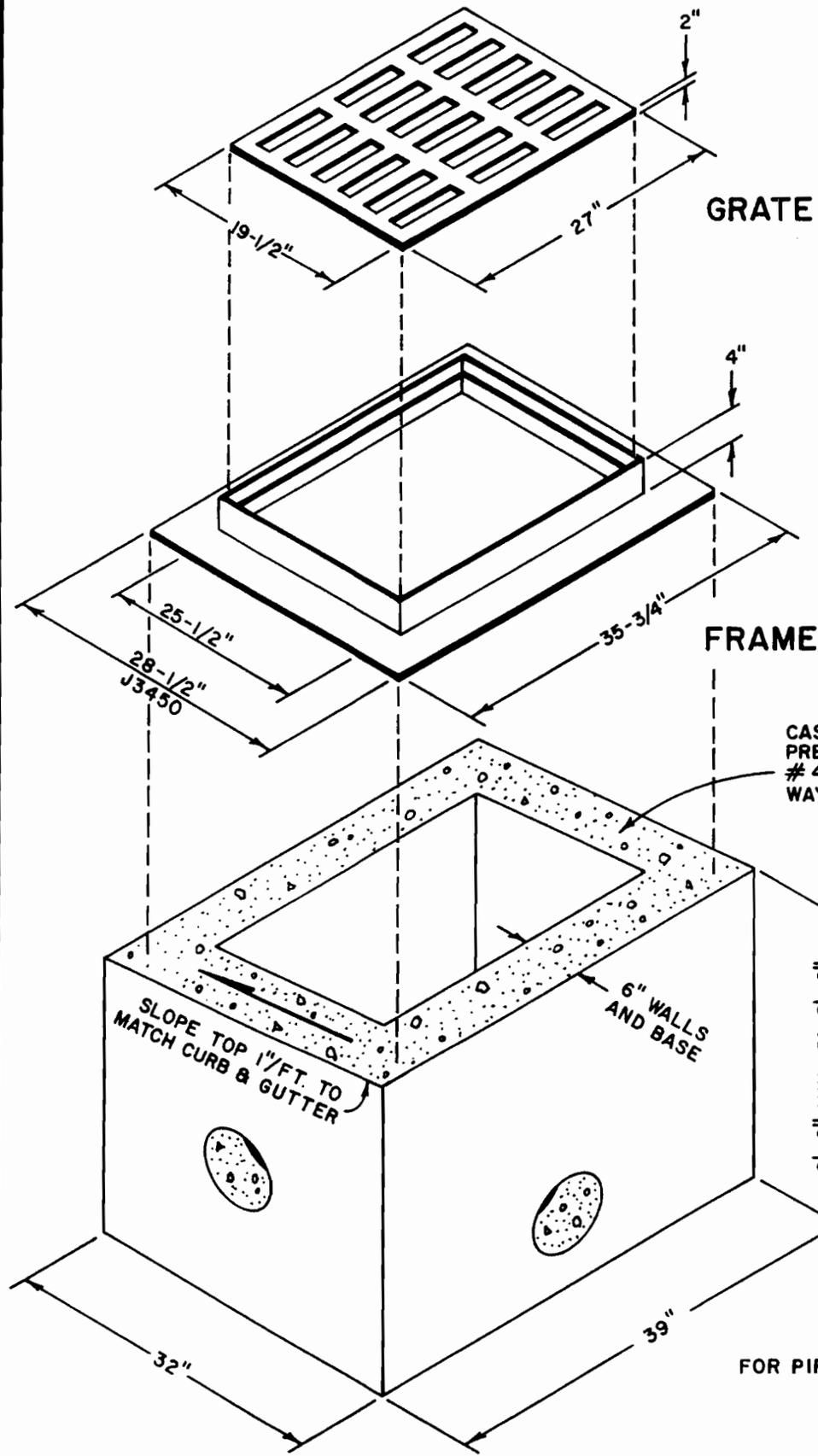
1. ALL PORTLAND CEMENT CONCRETE SHALL BE COLORADO DIVISION OF HIGHWAYS CLASS "B". (SECTION 601.02)
2. ANY EXISTING PAVEMENT NOT DESIGNATED FOR REMOVAL WHICH IS DISTURBED BY CONSTRUCTION SHALL BE REPLACED IN-KIND BY CONTRACTOR.
3. ALL WORK WITHIN PUBLIC RIGHT-OF-WAY SHALL BE PERFORMED BY A LICENSED CONTRACTOR, BONDED WITH THE CITY OF DURANGO.
4. SEE PLAN SHEETS FOR ALL PIPE SIZES AND ELEVATIONS WHICH WILL DETERMINE SIZES OF STRUCTURES AND OPENINGS.
5. ALL WORK SHALL BE IN ACCORDANCE WITH THE PROJECT SPECIFICATIONS.

GRATE AND FRAME

- ALL GRATES SHALL BE BICYCLE SAFE.
- ALL INLETS IN SAGS SHALL HAVE CURB OPENING.
1. ADJACENT TO CURB - CURB OPENING REQUIRED; USE J-MARK J-3516 OR NEENAH R-3246 WITH 1" CURB FACE RADIUS.
 2. ADJACENT TO CURB - NO CURB OPENING REQUIRED; USE J-MARK J-3446, CASTING NO. 12 OR NEENAH R-3246-1.
 3. INLET NOT ADJACENT TO CURB; USE J-MARK J-3450 OR APPROVED SUBSTITUTE.

CITY OF DURANGO	
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ENGINEERING DIVISION	
GENERAL SPECIFICATIONS	
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DWG. NO.	SS-2

GRATE DIMENSIONS SHOWN ARE
J MARK J-3450



CITY OF DURANGO	
PUBLIC WORKS DEPARTMENT	
ENGINEERING DIVISION	
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DATE	11-30-83
APPV. BY	
DWG. NO.	SS-2

SHEET 2 OF 2

CAST IN PLACE OR
PRECAST CONCRETE WITH
#4 REBAR AT 7" C.C. 2
WAYS IN ALL WALLS & BASE

SLOPE TOP 1"/FT. TO
MATCH CURB & GUTTER

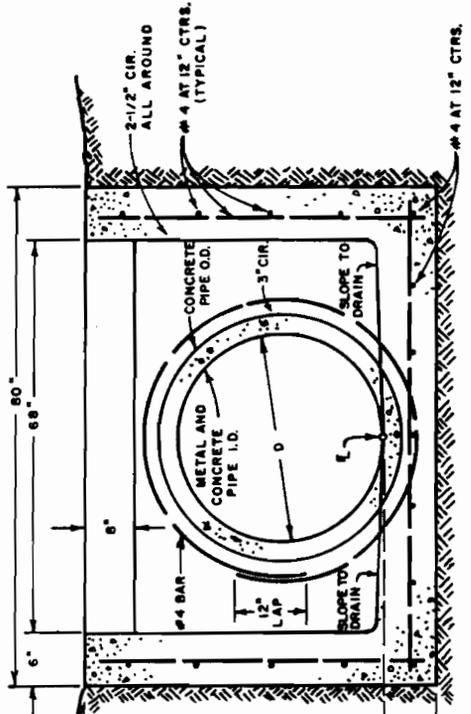
6" WALLS
AND BASE

2'-6" MIN. TO 5'-0"
MAX. (SEE PLAN)

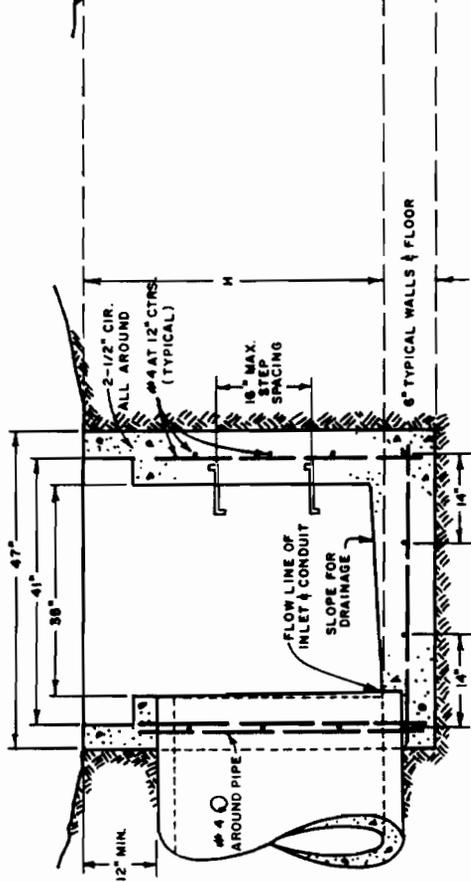
BOX

FOR PIPE SIZES 18" DIA. OR LESS

STORM DRAIN INLET



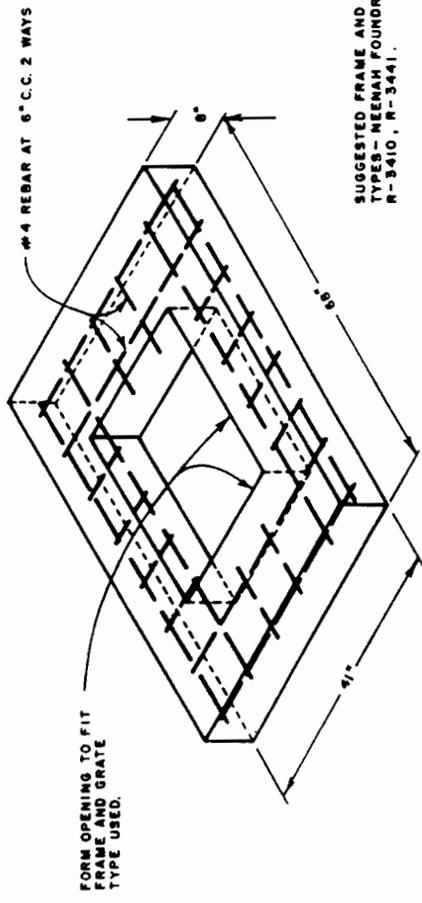
LONGITUDINAL CROSS SECTION



TRANSVERSE CROSS SECTION

NOTES

- CONCRETE SHALL BE CLASS A OR B.
- ALL EXPOSED CONCRETE SURFACES SHALL RECEIVE CLASS 1 FINISH.
- FOOTINGS IN ROCK SHALL BE POURED OUT TO ROCK AND NOT FORMED.
- INLET MAY BE CAST IN PLACE OR PRECAST.
- "H" STEPS WILL BE REQUIRED WHEN INLET FOR PIPE SIZES 18" DIA. TO 42" DIA.

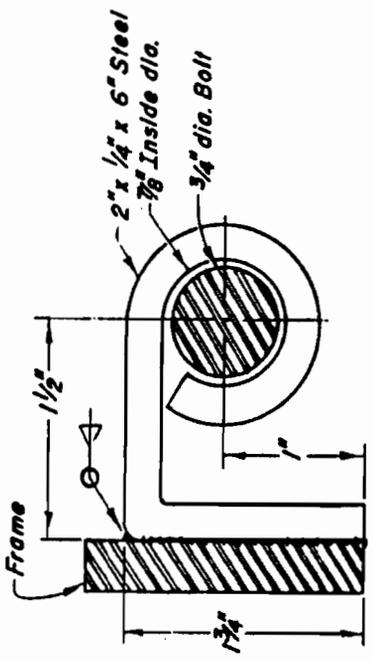


TOP SLAB

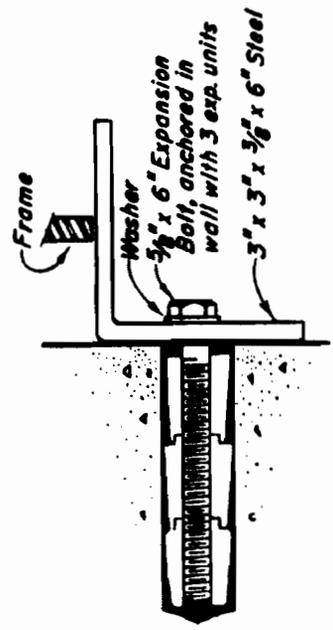
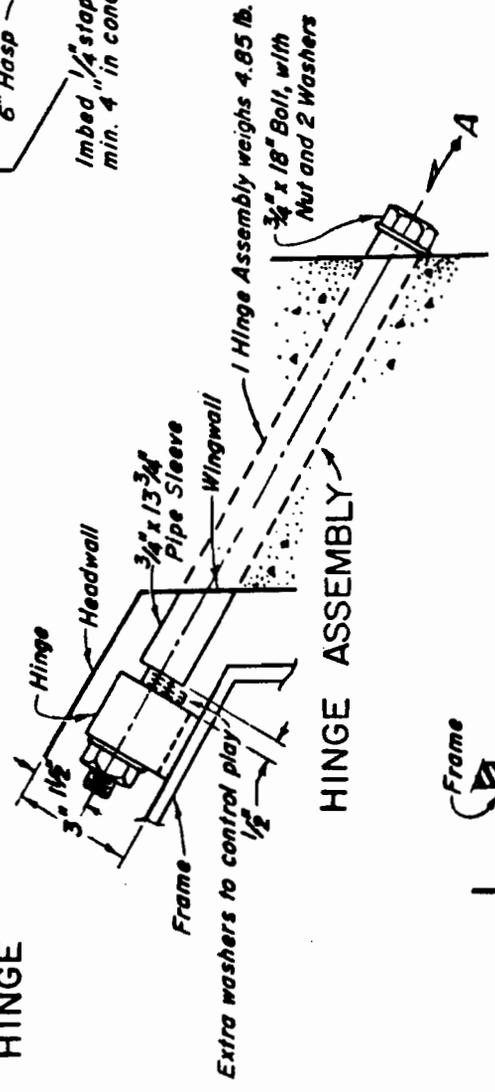
SUGGESTED FRAME AND GRATE TYPES - NEENAH FOUNDRY R-3410, R-3441.

CITY OF DURANGO	
PUBLIC WORKS DEPARTMENT	
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APPV. BY	
DWG. NO.	SS-4

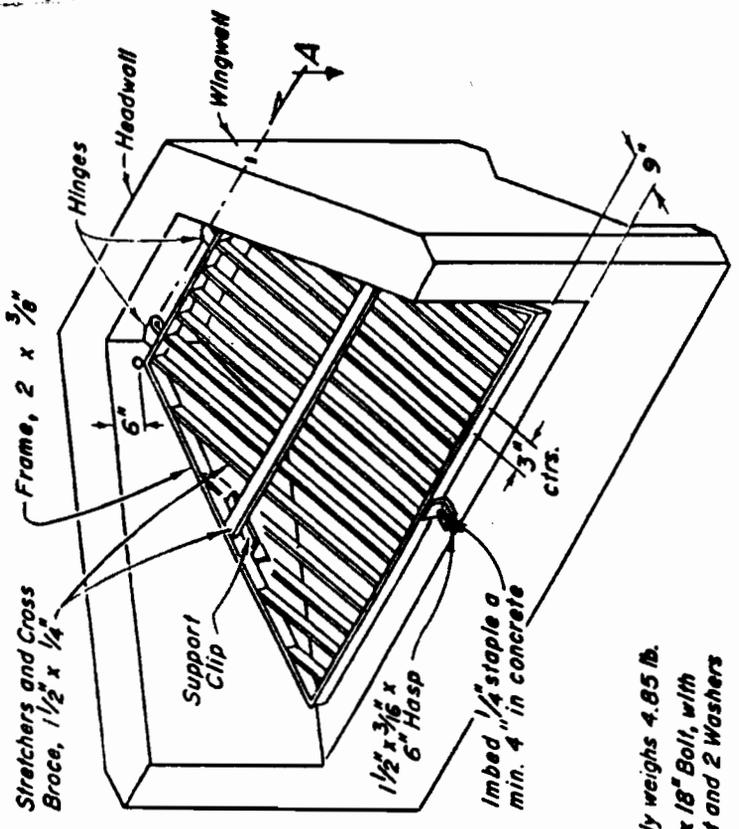
LARGE STORM DRAIN INLET



HINGE



SUPPORT CLIP

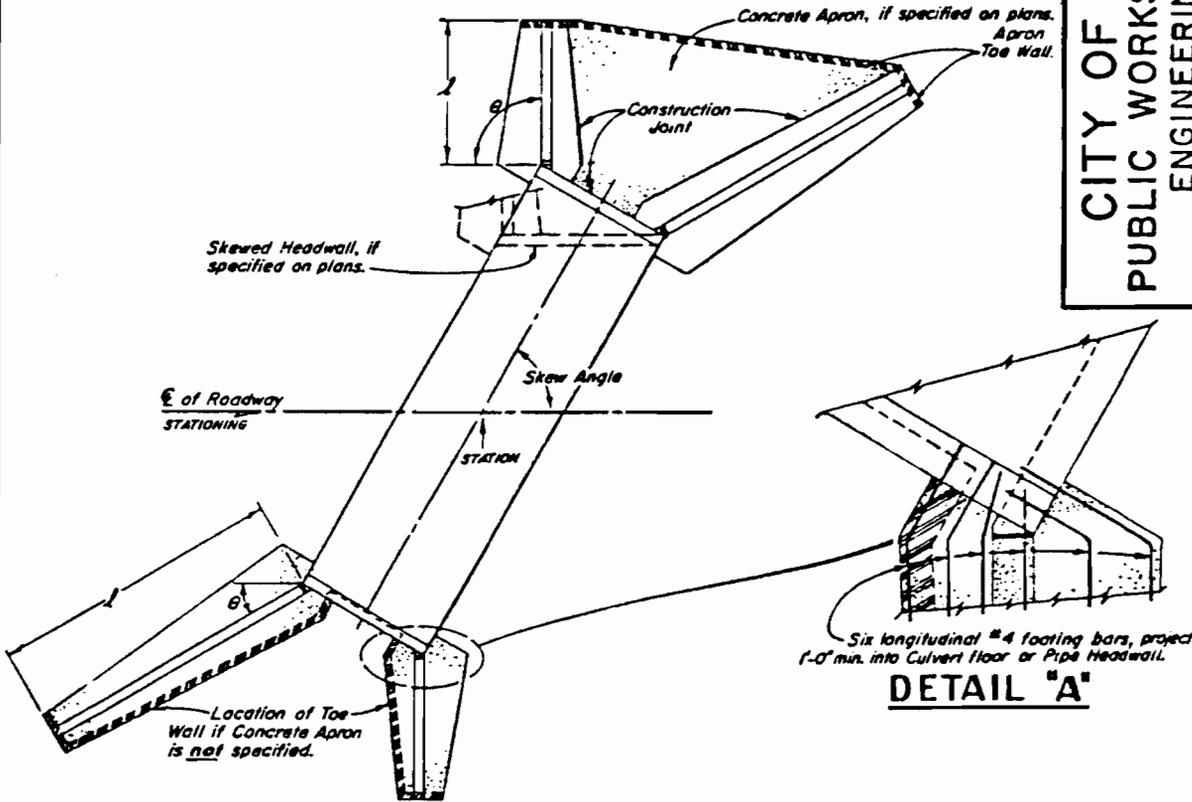


STORM SEWER TRASH GUARD DETAILS

DRAWINGS TAKEN FROM COLO. HWY. DEPT. STANDARDS.

CITY OF DURANGO PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION	
GENERAL SPECIFICATIONS	
DWN. BY D.F.	DATE 11-30-83
APPV. BY	DWG. NO. SS-5

CITY OF DURANGO PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION		DATE	2-10-84
		OWN. BY	D.F.
		APPV. BY	
GENERAL SPECIFICATIONS		DWG. NO.	SS-6



TYPICAL CULVERT LAYOUT

GENERAL NOTES

Revised CDOH M-601-20.

All exposed corners on concrete shall be chamfered $\frac{3}{4}$ ".

Wingwall footings and floor of Box Culvert shall be placed monolithically.

Expansion Joint Material shall conform to AASHTO M-213 and payment therefor shall be included in the price for Concrete, (Box Culvert) or (Wall).

Dimensions "H", "Ba", "Rise", "k", "l", "m" and angles for wingwalls shall be as shown on the plans.

The minimum splice length for common bar sizes shall be:

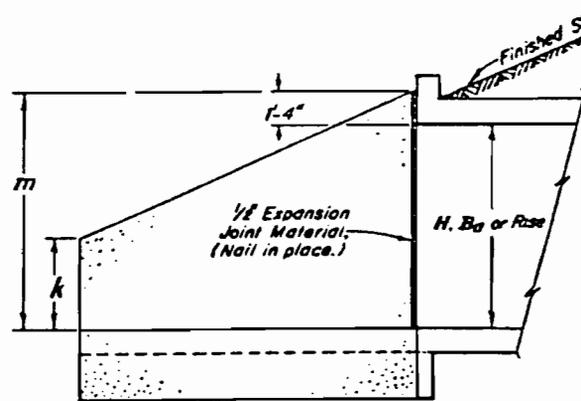
BAR SIZE	#4	#6
SPLICE LENGTH	1'-0"	1'-6"

DESIGN DATA:

Unit Stresses: $f_s = 20,000$ psi
 $f_c = 1,200$ psi
 $n = 10$

Equivalent Fluid Pressure = 30 lbs./cu.ft.
 Maximum Toe Pressure = 1 Ton/sq. ft.

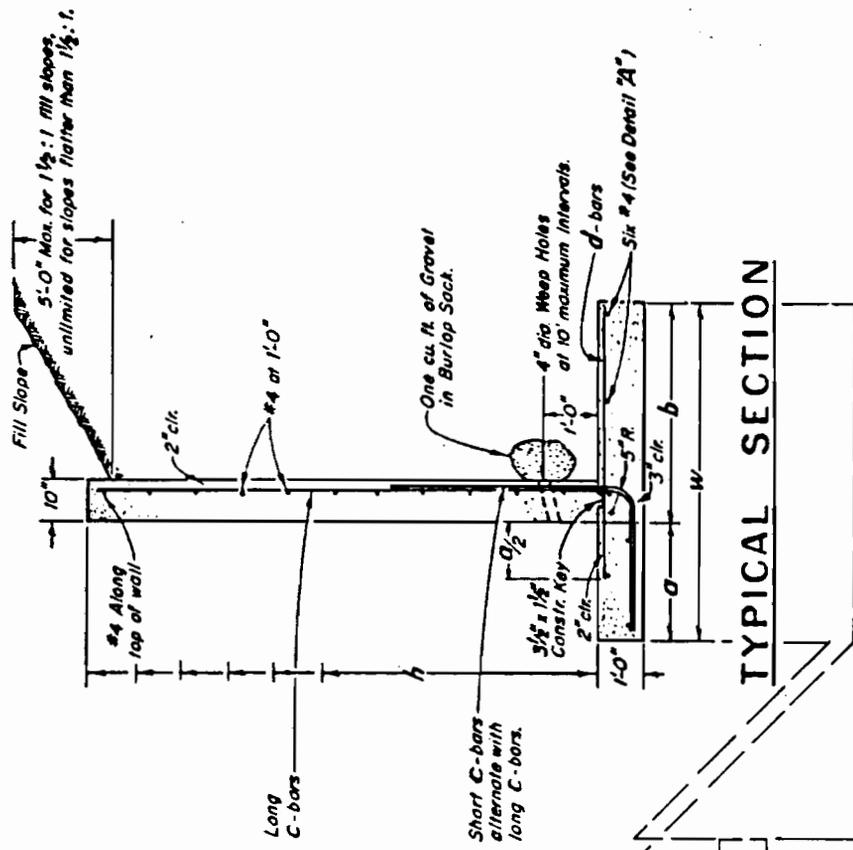
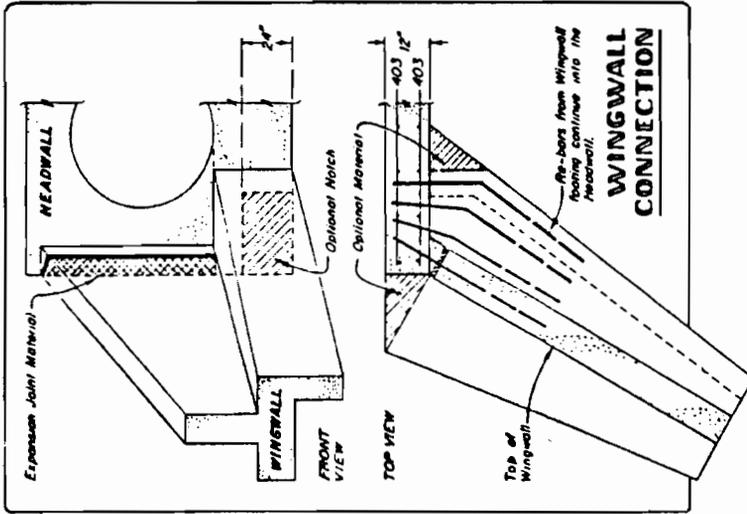
All construction joints shall be thoroughly cleaned before fresh concrete is poured.



WING ELEVATION

$m = H, Ba \text{ or Rise} + (1'-4")$ unless otherwise shown on Plans.

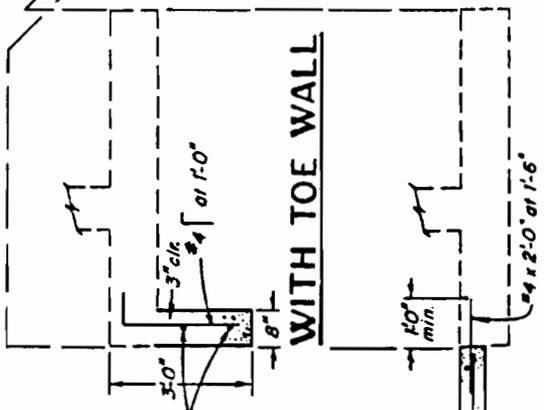
WINGWALL DETAILS



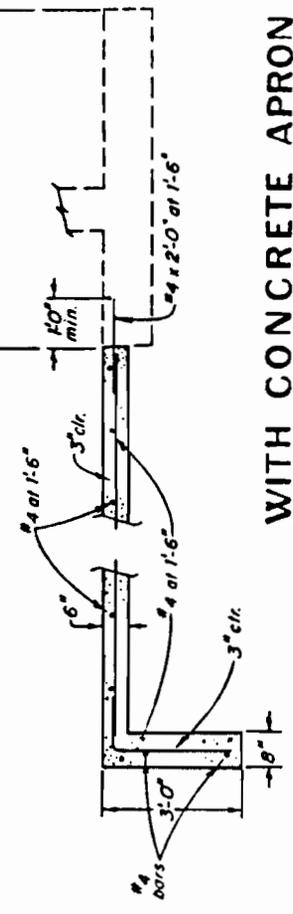
WINGWALL DETAILS

NOTE: REVISED CDOH M-601-20 & 10

CITY OF DURANGO	
PUBLIC WORKS DEPARTMENT	
ENGINEERING DIVISION	
GENERAL SPECIFICATIONS	
DWN BY	D.F.
DATE	2-10-84
APPV. BY	DWG. NO. SS-6



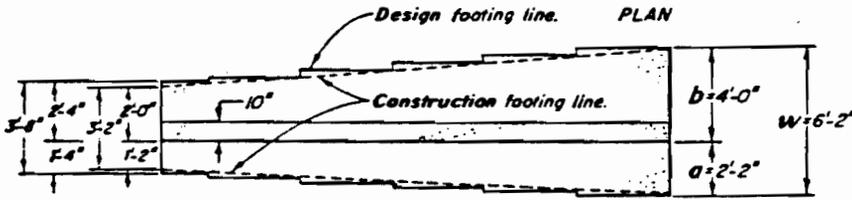
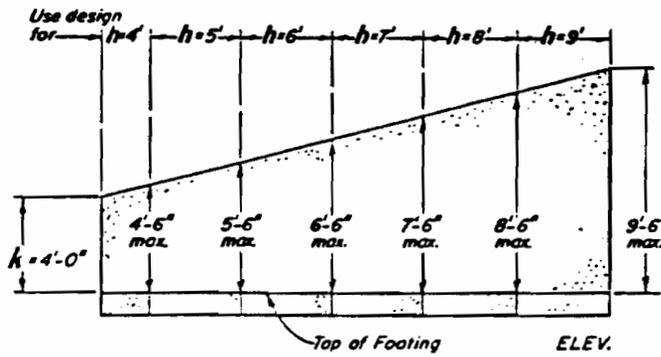
QUANTITIES FOR TOE WALL ONLY
 Concrete 0.049 cu yd per lin. ft.
 Reinforcement 3.4 lb. per lin. ft.



APRON TOE WALL

WITH CONCRETE APRON

Re-bar: .89lb/sq. ft.

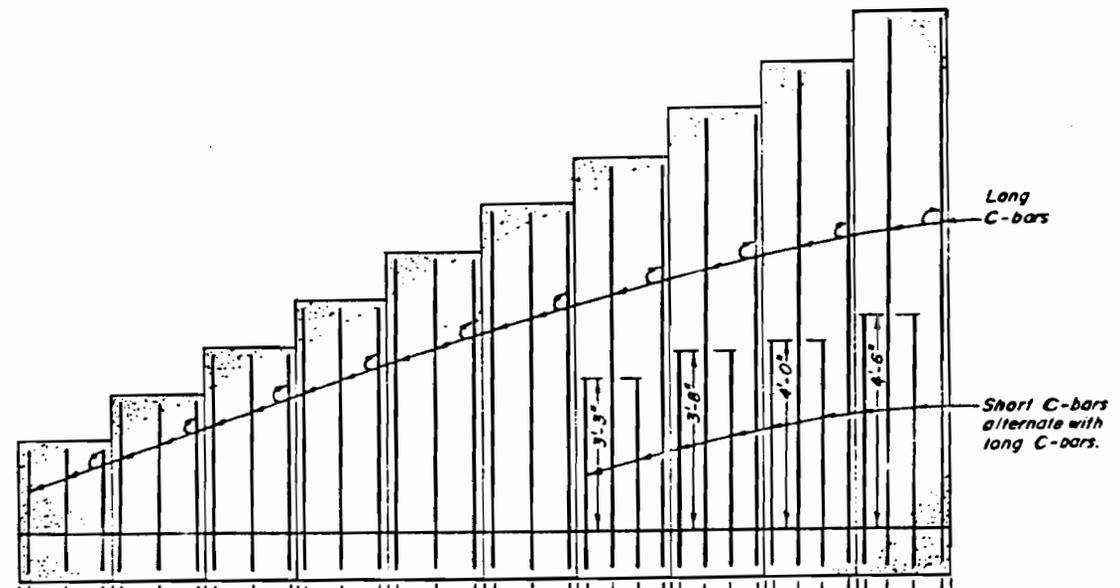


NOTE: REVISED CDOH M-601-20

CITY OF DURANGO
PUBLIC WORKS DEPARTMENT
ENGINEERING DIVISION
GENERAL SPECIFICATIONS

DWN. BY D.F. DATE 2-10-84
 APPV. BY DWG. NO. SS-6

DESIGN EXAMPLE



$e =$	1'-6"	1'-6"	1'-6"	1'-6"	1'-0"	0'-8 1/2"	1'-0"	0'-9 1/2"	0'-7"	0'-5 1/2"	ctrs.
$h =$	2'	3'	4'	5'	6'	7'	8'	9'	10'	11'	
$a =$	1'-0"	1'-2"	1'-4"	1'-6"	1'-8"	1'-10"	2'-0"	2'-2"	2'-4"	2'-6"	
$b =$	1'-8"	2'-0"	2'-4"	2'-8"	3'-0"	3'-4"	3'-8"	4'-0"	4'-4"	4'-8"	
$w =$	2'-8"	3'-2"	3'-8"	4'-2"	4'-8"	5'-2"	5'-8"	6'-2"	6'-8"	7'-2"	
C & d bars	#4 at 1'-6"	#4 at 1'-6"	#4 at 1'-6"	#4 at 1'-6"	#4 at 1'-0"	#4 at 8 1/2"	#6 at 1'-0"	#6 at 9 1/2"	#6 at 7"	#6 at 5 1/2"	ctrs.
*Conc. cu yd/ft.	0.161	0.210	0.259	0.308	0.358	0.407	0.457	0.506	0.556	0.604	
*Reinf. lb/ft.	8.0	9.3	10.7	12.1	16.2	21.7	29.0	37.0	51.0	67.3	

* Does not include Toe Wall quantities.

DESIGN TABLE

WINGWALL DETAILS

QUANTITIES FOR ONE CONCRETE HEADWALL (Cubic Yards)

		DIAMETER (AND EQUIVALENT DIAMETER) inches (S = Span) (R = Rise)											
		18		24		30		36		42		48	
TYPE	MAT'L	SINGLE	DOUBLE	SINGLE	DOUBLE	SINGLE	DOUBLE	SINGLE	DOUBLE	SINGLE	DOUBLE	SINGLE	DOUBLE
C	RCP	1.0	1.3	1.5	2.0	2.0	2.7	2.8	3.6	3.6	4.6	4.6	6.0
	CMP	1.1	1.4	1.6	2.1	2.2	3.0	3.0	4.0	3.9	3.3	3.0	6.8
A	RCP	0.9	1.2	1.3	1.8	1.7	2.3	2.3	3.1	2.9	3.9	3.1	4.4
	CMP	0.9	1.3	1.4	1.9	1.8	2.4	2.4	3.4	3.2	4.4	3.4	5.0
		S	R	S	R	S	R	S	R	S	R	S	R
		22	13	29	18	36	22	43	27	50	31	58	35

QUANTITIES FOR ONE MASONRY HEADWALL (Cubic Yards)

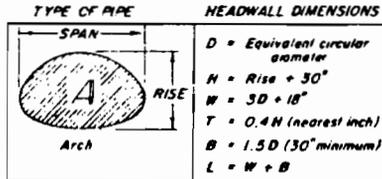
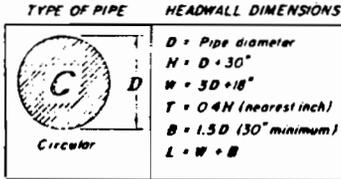
		18		24		30		36		42		48	
TYPE	MAT'L	SGL	DBL										
C	RCP	1.3	1.7	1.9	2.5	2.6	3.4	3.5	4.3	4.4	6.1	5.6	7.2
	CMP	1.4	1.8	2.0	2.7	2.8	3.7	3.8	5.0	4.8	6.8	6.1	8.2
A	RCP	1.4	1.9	2.1	2.8	2.9	3.9	3.9	5.3	5.0	7.2	6.4	8.8
	CMP	1.4	1.9	2.1	2.9	3.0	4.1	4.0	5.5	5.2	7.6	6.6	9.2
		S	R	S	R	S	R	S	R	S	R	S	R
		22	13	29	18	36	22	43	27	50	31	58	36

CONCRETE FOR INTERCEPTING HEADWALL (Cubic Yards)

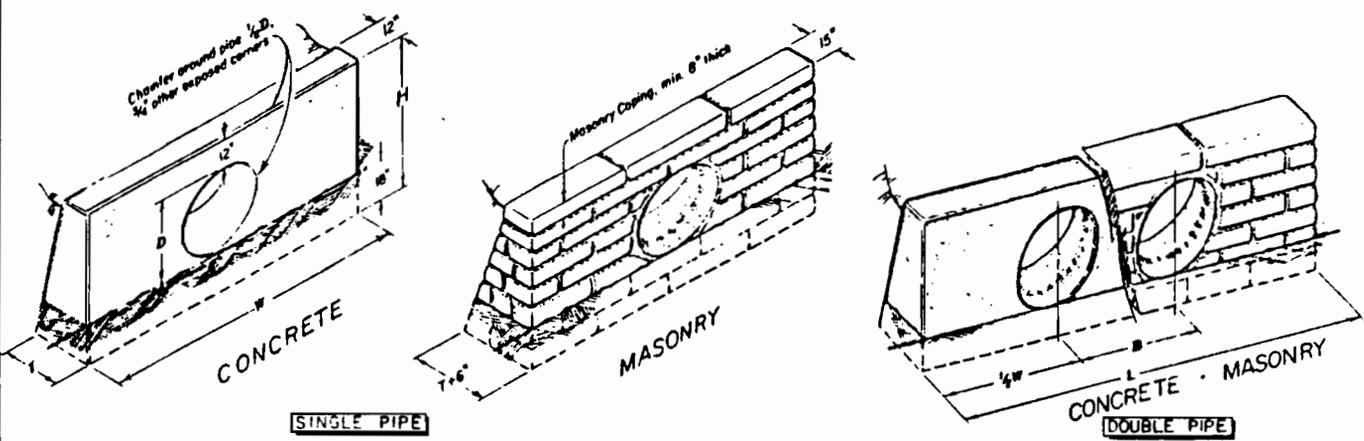
TYPE	MAT'L	18	24	30	36	42	48
C	RCP	1.6	1.9	2.2	2.5	2.8	3.1
	CMP	1.7	2.0	2.3	2.6	2.9	3.3

PAVING FOR CULVERT OUTLET (Cubic Yards)

Thick - Material	18	24	30	36	42	48
4" CONCRETE	0.4	0.8	1.2	1.7	2.4	3.1
12" RIPRAP	1.5	2.3	3.6	5.2	7.1	9.3
18" RIPRAP	2.0	3.5	5.4	7.8	10.7	13.9

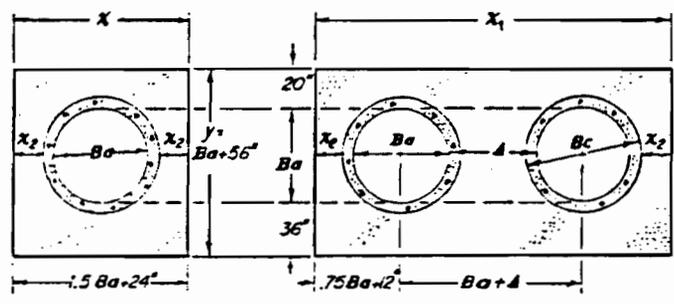


NOTE: Volume occupied by pipe has been deducted



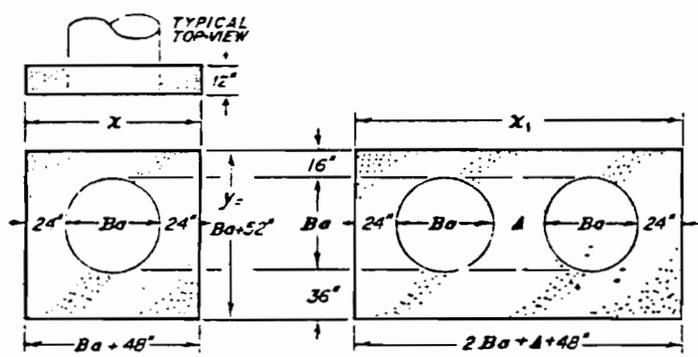
**HEADWALLS FOR PIPES
15" TO 48" DIAMETER**

NOTE: REVISED CDOH M-601-12



HEADWALL FOR RCP - ROUND

DIMENSIONS										QUANTITIES			
Ba	Bc	x	A	x1	A1	y	B	x2		CONCRETE		STEEL	
in.	in.	ft-in.	in.	ft-in.	in.	ft-in.	in.	in.		SGL	DBL	SGL	DBL
										cu. yd.	cu. yd.	lbs.	lbs.
60	72	9-6	7	17-0	10	9-8	11	21		2.35	399	236	414
66	79	10-3	11 1/2	18-6	7	10-2	14	22		2.60	444	249	453
72	86	11-0	10	20-0	10	10-8	17	23		2.85	491	270	476
78	93	11-9	8 1/2	21-3	11	11-2	11	24		3.11	529	306	527
84	100	12-6	7	22-6	7	11-8	14	25		3.38	568	333	572
90	107	13-3	11 1/2	23-9	8 1/2	12-2	17	26		3.66	608	335	593
96	114	14-0	10	25-0	10	12-8	11	27		3.94	648	379	649
102	121	14-9	8 1/2	26-3	11 1/2	13-2	14	28		4.24	689	400	664
108	128	15-6	7	27-6	7	13-8	17	29		4.54	730	424	707



HEADWALL FOR CMP - ROUND

DIMENSIONS										QUANTITIES			
Ba	x	A	x1	A1	y	B				CONCRETE		STEEL	
in.	ft-in.	in.	ft-in.	in.	ft-in.	in.				SGL	DBL	SGL	DBL
										cu. yd.	cu. yd.	lbs.	lbs.
60	9-0	10	16-6	7	9-4	18				2.38	4.25	217	396
65	9-6	7	17-9	8 1/2	9-10	12				2.58	4.70	252	454
72	0-0	10	19-0	10	10-4	15				2.78	5.17	255	472
78	10-6	7	20-0	10	10-10	18				2.98	5.56	276	495
84	11-0	10	21-0	10	11-4	12				3.19	5.95	297	553
90	11-6	7	22-0	10	11-10	15				3.40	6.36	317	571
96	12-0	10	23-0	10	12-4	18				3.62	6.79	321	597
102	12-6	7	24-0	10	12-10	12				3.84	7.21	364	663
108	13-0	10	25-0	10	13-4	15				4.06	7.63	362	678

GENERAL NOTES

- Revised CDOH M-601-10.
- Headwall shall be perpendicular to the culvert $\&$ unless otherwise shown on the plans.
- For Wingwall details, see Standard M-601-WW.
- Volume occupied by pipe has been deducted from Steel and Concrete quantities.
- Δ When 2 or more conduits are laid side by side they shall be placed so that the adjacent pipes will be $\frac{1}{2}$ Inside Diameter or $\frac{1}{2}$ Inside Span or $\frac{1}{3}$ feet apart (including wall thickness) whichever is less.

**HEADWALLS FOR PIPES
60" DIAMETER
AND ABOVE**

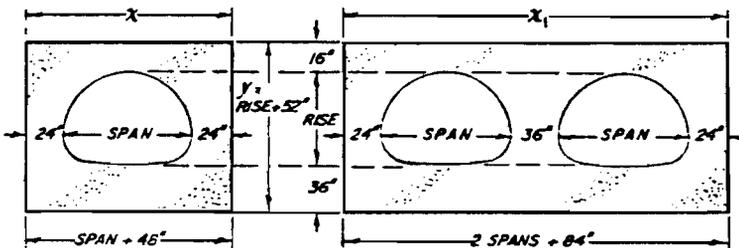
***SKEW FACTOR TABLE**

SKEW ANGLE A°	FACTOR (cosec A°)
90	1.000
85	1.004
80	1.015
75	1.035
70	1.064
65	1.103
60	1.155
55	1.221
50	1.305
45	1.414
40	1.556
35	1.743
30	2.000

* Multiply X (or X1) dimension and all quantities by factor if Culvert Skew is less than 90° and Headwall remains parallel to the roadway $\&$.

HEADWALL FOR CMP ~ ARCH

EQUIV. B ₀	DIMENSIONS		QUANTITIES								CONCRETE				STEEL	
	SPAN	RISE	X	A	x ₁	A ₁	y	B	SGL cu. yd.	DBL cu. yd.	SGL lbs.	DBL lbs.	SGL lbs.	DBL lbs.		
	in.	in.	ft.-in.	in.	ft.-in.	in.	ft.-in.	in.								
72	81	59	10-9	8 1/2	20-6	7	9-3	17 1/2	2.72	5.10	250	467				
78	87	63	11-3	11 1/2	21-6	7	9-7	10 1/2	2.85	5.34	275	531				
84	95	67	11-9	8 1/2	22-10	9	9-11	12 1/2	3.08	5.79	290	547				
90	103	71	12-7	7 1/2	24-2	11	10-3	15	3.30	6.21	321	591				
96	112	75	13-4	12	25-8	8	10-7	16 1/2	3.52	6.65	314	606				
102	117	79	13-9	8 1/2	26-6	7	10-11	9 1/2	3.63	6.86	356	672				
108	128	83	14-8	8	28-4	12	11-3	11 1/2	3.96	7.51	376	699				



HEADWALL FOR STRUCTURAL PLATE ~ ARCH

EQUIV. B ₀	DIMENSIONS		QUANTITIES								CONCRETE				STEEL	
	SPAN	RISE	X	A	x ₁	A ₁	y	B	SGL cu. yd.	DBL cu. yd.	SGL lbs.	DBL lbs.	SGL lbs.	DBL lbs.		
	ft.-in.	ft.-in.	ft.-in.	in.	ft.-in.	in.	ft.-in.	in.								
66	6-1	4-7	10-1	10 1/2	19-2	11	8-11	15 1/2	2.52	4.70	232	424				
75	7-0	5-1	11-0	10	21-0	10	9-5	9 1/2	2.80	5.25	282	509				
84	7-11	5-7	11-11	9 1/2	22-10	9	9-11	12 1/2	3.08	5.79	291	540				
93	8-0	6-1	12-10	9	24-8	8	10-5	15 1/2	3.36	6.33	309	622				
102	9-9	6-7	13-9	8 1/2	26-6	7	10-11	9 1/2	3.63	6.86	379	673				
111	10-11	7-1	14-11	9 1/2	28-10	9	11-5	12 1/2	4.05	7.67	377	711				
120	11-10	7-7	15-10	9	30-8	8	11-11	15 1/2	4.36	8.28	395	731				
132	12-10	8-4	16-10	9	32-8	8	12-8	11	4.75	9.03	441	839				
141	14-1	8-9	18-1	10 1/2	35-2	11	13-1	13 1/2	5.17	9.86	448	931				
150	15-4	9-3	19-4	12	37-8	8	13-7	16 1/2	5.69	10.88	490	953				
159	15-10	9-10	19-10	9	38-8	8	14-2	11	5.89	11.25	534	1019				

*SKEW FACTOR TABLE

SKEW ANGLE A°	FACTOR (cosec A°)
90	1.000
85	1.004
80	1.015
75	1.035
70	1.064
65	1.103
60	1.155
55	1.221
50	1.305
45	1.414
40	1.556
35	1.743
30	2.000

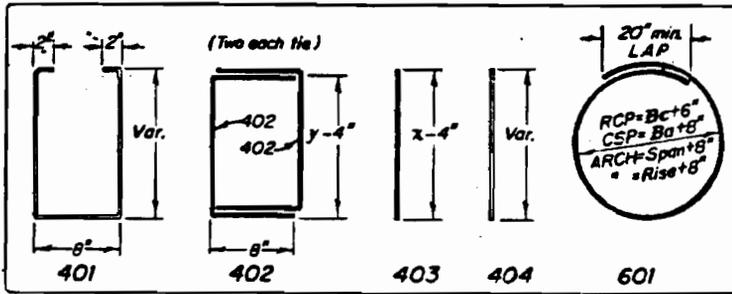
* Multiply X (or X₁) dimension and all quantities by factor if Culvert Skew is less than 90° and Headwall remains parallel to the roadway.

NOTE:
REVISED CDOH M-601-10

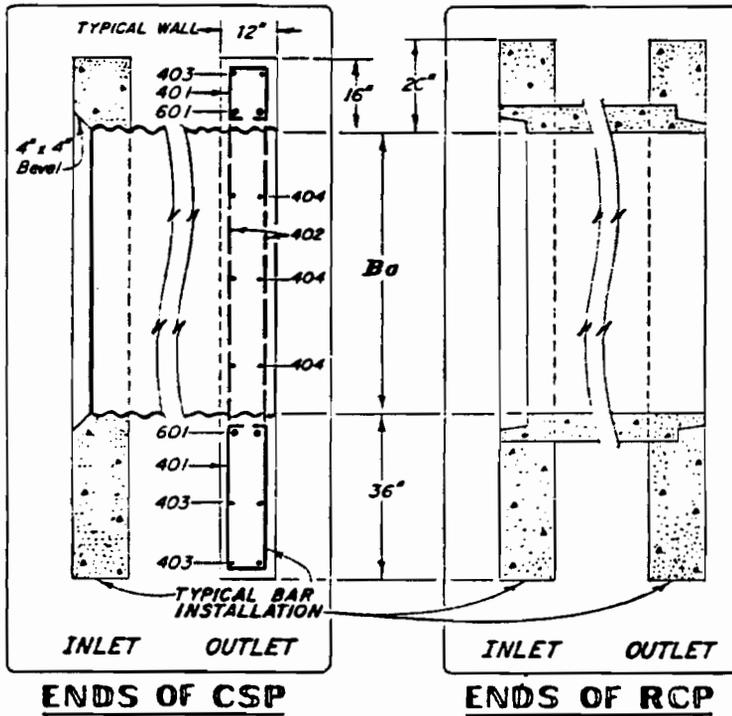
HEADWALLS FOR PIPES 60" DIAMETER AND ABOVE

CITY OF DURANGO
PUBLIC WORKS DEPARTMENT
ENGINEERING DIVISION

GENERAL SPECIFICATIONS	
DWN. BY	D.F.
DATE	2-10-84
APPV. BY	
DWG. NO	SS-7



BAR BENDING

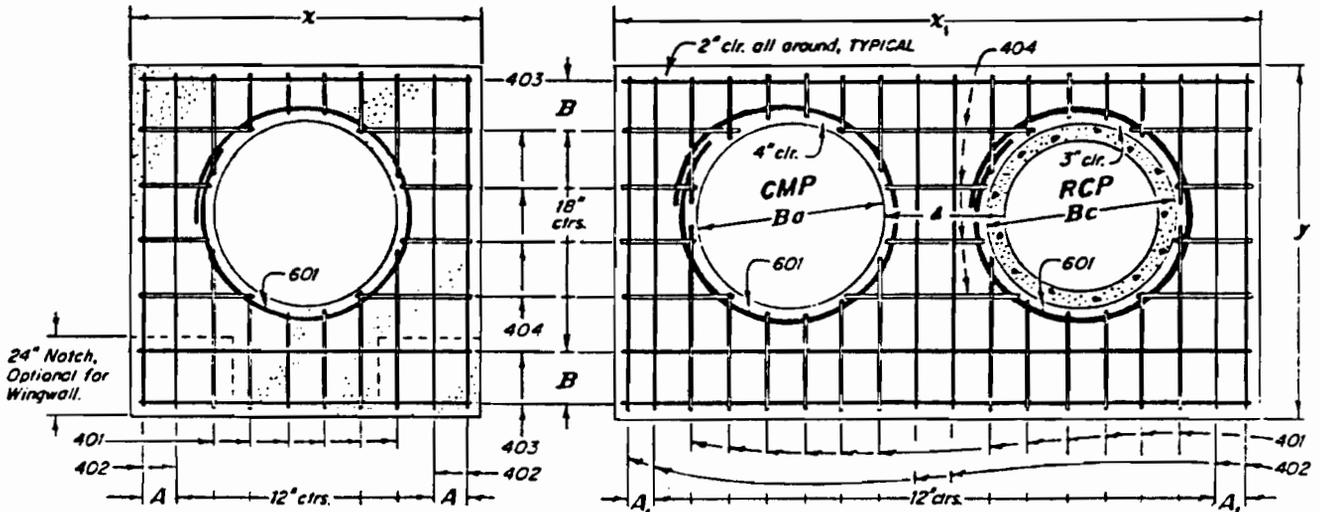


ENDS OF CSP

ENDS OF RCP

HEADWALL FOR SINGLE PIPE

HEADWALL FOR DOUBLE PIPE



TYPICAL BAR LAYOUT FOR CONCRETE HEADWALLS

SHEET 4 OF 4

**CITY OF DURANGO
PUBLIC WORKS DEPARTMENT
ENGINEERING DIVISION**

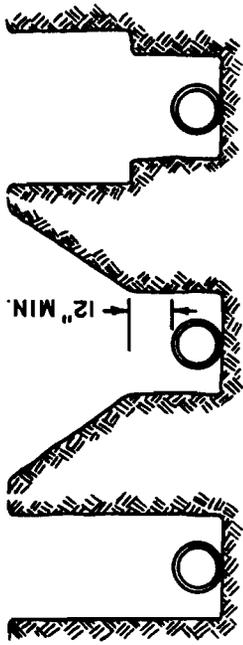
GENERAL SPECIFICATIONS

OWN. BY D.F. DATE 2-10-84

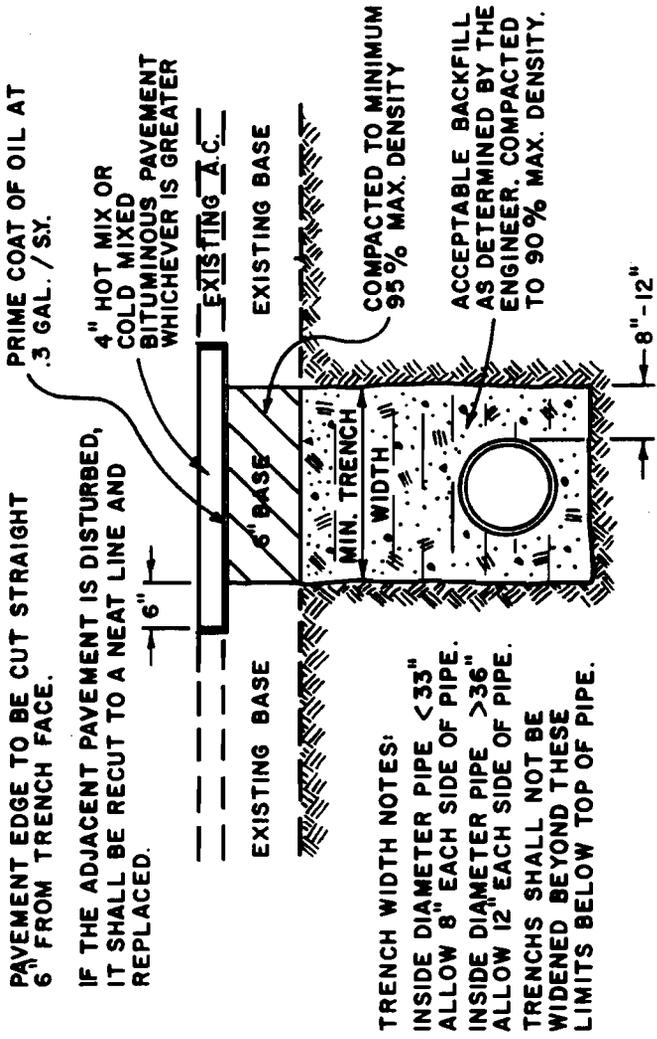
APP.V. BY DWG. NO SS-7

**HEADWALLS FOR PIPES
60" DIAMETER
AND ABOVE**

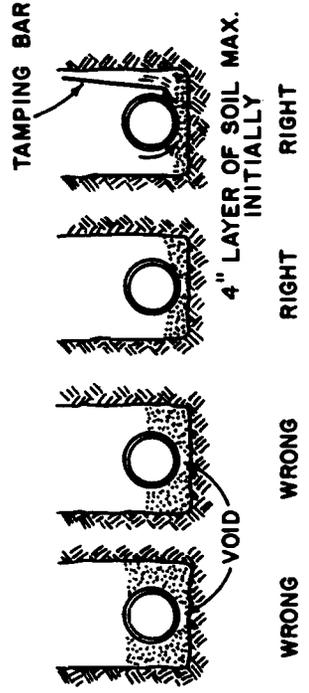
NOTE:
REVISED CDOH M-601-10



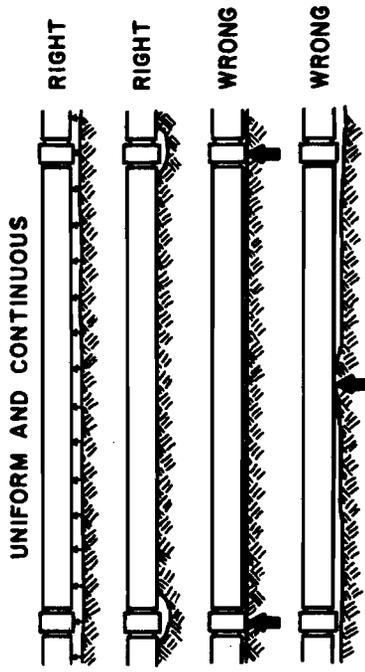
TRENCH SHAPE DETAIL



TRENCH WIDTH NOTES:
 INSIDE DIAMETER PIPE < 36"
 ALLOW 8" EACH SIDE OF PIPE.
 INSIDE DIAMETER PIPE > 36"
 ALLOW 12" EACH SIDE OF PIPE.
 TRENCHES SHALL NOT BE
 WIDENED BEYOND THESE
 LIMITS BELOW TOP OF PIPE.



BEDDING COMPACTION DETAIL

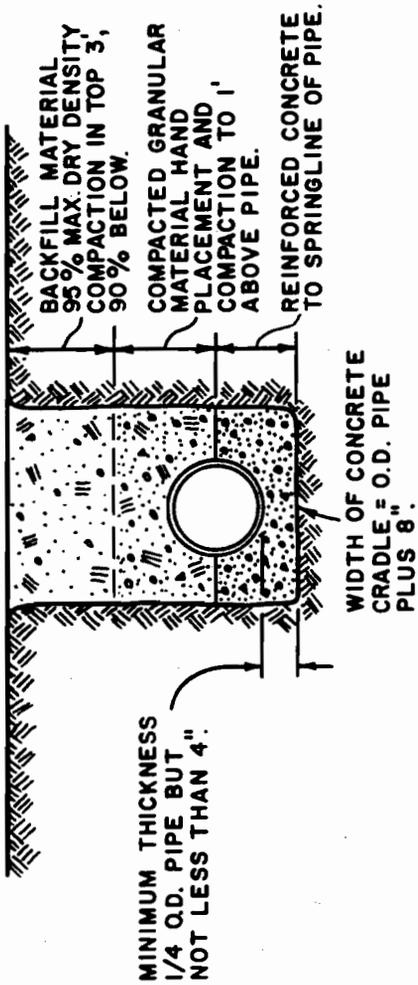


TRENCH BOTTOM DETAIL

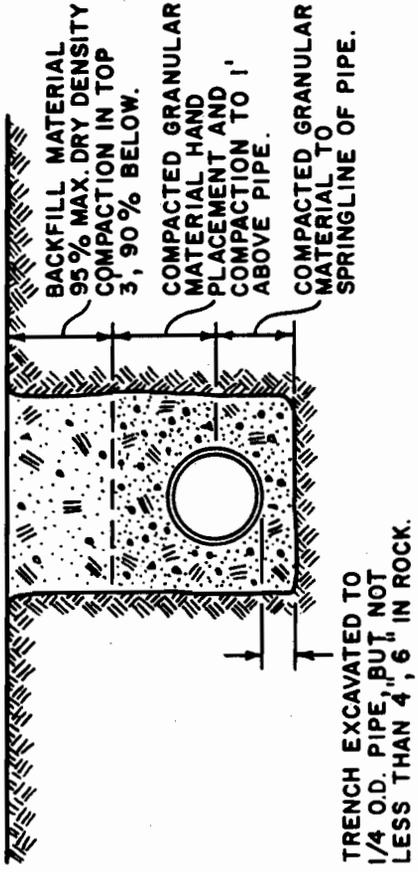
CITY OF DURANGO	
PUBLIC WORKS DEPARTMENT	
ENGINEERING DIVISION	
GENERAL SPECIFICATIONS	
OWN. BY	DATE
D.F.	11-30-83
APPV BY	DWG. NO.
	0-1

STANDARD TRENCH DETAIL

CLASS A BEDDING

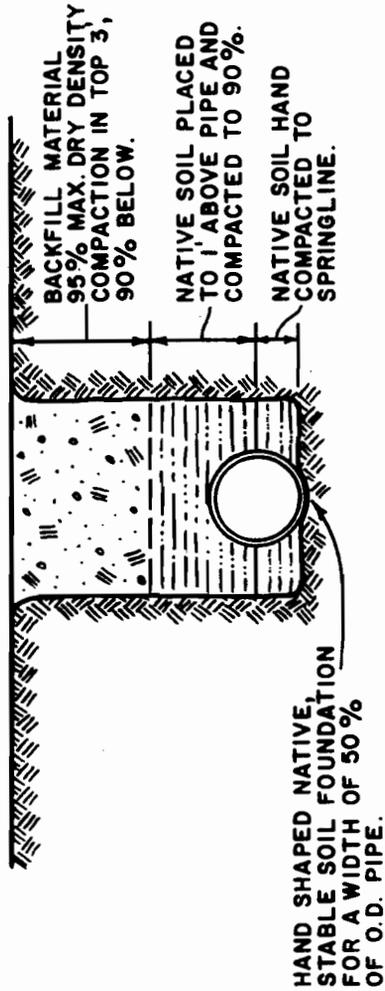


CLASS B BEDDING



DENSITY TESTING PER AASHTO - T 180

CLASS C BEDDING



STANDARD BACKFILL DETAILS

CITY OF DURANGO
PUBLIC WORKS DEPARTMENT
ENGINEERING DIVISION

GENERAL SPECIFICATIONS	
DWN. BY D.F.	DATE 11-30-83
APPV. BY	DWG. NO. 0-2

