

SECTION 3000 - SANITARY SEWERS

3001 SCOPE. This section applies to sanitary sewer construction and shall consist of furnishing all labor, materials, and equipment for the complete installation of sewers and appurtenances.

3002 GENERAL. It is understood that throughout this section these specifications may be modified or deleted by appropriate items in the contract documents.

When reference is made to a standard specification (ASTM, AWWA, etc.), the specification referred to shall be understood to mean the latest revision of said specification except as otherwise noted in the contract documents.

3003 MATERIALS.

A. Vitrified Clay Pipe

Pipe and Fittings ASTM C700 extra strength.

Jointing Materials

Ordinary Joints Factory molded plastic, ASTM C425; or PVC plain end couplings, ASTM C594, Type B.

Field Cut Joints Dickey "Field Union" or equivalent.

B. Reinforced Concrete Pipe

Pipe ASTM C76, except as modified herein.

Fine Aggregate Clean natural sand, ASTM C33. Artificial or manufactured sand will not be permitted.

Cement ASTM C150, containing not more than five (5) percent tricalcium aluminate.

Gaskets ASTM 361 polymer shall be neoprene or other synthetic rubber. Natural rubber will not be acceptable.

C. Ductile Iron Pipe

Pipe	ANSI A21.51; ASTM A536, Grade 60-42-10, Thickness Class 50 unless otherwise required by the city engineer.
Mechanical and Push-On Joint	ANSI 21.11, except gaskets shall be neoprene or synthetic rubber. Natural rubber will not be acceptable.
Flanged Joints	ANSI A21.10.
Fittings	ANSI A21.10, pressure rating of not less than that specified for pipe.
Lining and Coating	All pipe, fittings, and specials shall be cement-mortar lined in accordance with ANSI A21.14, and shop coated with manufacturer's standard coal tar coating.

D. Polyvinyl Chloride (PVC) Pipe

Pipe	ASTM D3034, Type PSM, SDR 35. Pipe material shall conform to ASTM D1784 and shall have a cell classification of 12454-B, 12454-C or 13364-B. Sizes 18" to 36" shall conform to ASTM F679-BO. Minimum pipe stiffness for pipe used for stublines shall be SDR 23.5.
Joints	Flexible gasketed joints shall be compression type. Pipe shall be joined with an integral bell, bell-and-spigot rubber gasketed joint. Each integral bell joint shall consist of a formed bell complete with a single rubber gasket ring conforming to the requirements of ASTM D1869.

Fittings

Fittings defined as tee connections suitable for assembly to six (6) inch house or building sewers shall be saddle-type fittings molded of PVC material conforming to ASTM D1784. All fittings shall utilize rubber gasketed joints and shall be suitable for use with ASTM D3034, SDR 35, PVC sewer pipe.

3004 ALIGNMENT. Piping shall be laid to the lines and grades indicated on the drawings using laser beam equipment, surveying instruments or batter boards to maintain alignment and grade. If batter boards are used, they shall be erected at intervals not exceeding 25 feet. Not less than three batter boards shall be maintained in proper position at all times during the trench grading operation.

3005 HANDLING. Pipe, fittings, and appurtenances shall be transported, unloaded, stockpiled, distributed, and installed or otherwise handled in a manner which prevents damage thereto and which will ensure the delivery and installation thereof in a sound and acceptable condition. Hooks shall not be permitted to contact joint surfaces. Damaged pipe shall be removed from the site.

3006 CLEANING. The interior of all pipe and fittings shall be thoroughly cleaned before installation and shall be kept clean until the work has been accepted. All joint contact surfaces shall be kept clean until the joint is completed.

Whenever pipe laying is stopped, the open end of the pipe must be closed by using a pipe plug to prevent trench water, sand, and earth from entering the pipe. In no case shall said plug be removed and water allowed to enter the sewer until the engineer is satisfied that the sewer will not be injured by water coming in contact with the pipe, pipe backfill or subgrade. The engineer may require the contractor to pump the water from the trench before continuing trenching or pipe laying operations.

Every precaution shall be taken to prevent foreign material from entering the pipe during installation. No debris, tools, clothing, or other materials shall be placed in the pipe.

3007 LAYING PIPE. Lateral displacement of the pipe shall be prevented during embedment operations. Pipe shall not be laid in water, nor under unsuitable weather or trench conditions.

Pipe laying shall begin at the lowest elevation with bell ends facing the direction of laying except when reverse laying is permitted by the engineer.

3008 JOINTING. All joint preparation and jointing operations shall comply with the instructions and recommendations of the pipe manufacturer. Immediately before joints are pushed together, all joint surfaces shall be coated with the lubricant furnished with the pipe. The position and condition of each rubber gasket (unbonded gaskets) shall be checked with a feeler after the joint is completed.

Vitrified clay pipe joints shall conform to ASTM C12. Pipe having premolded joint rings or attached couplings shall be handled so that no weight, including the weight of the pipe itself, will bear on or be supported by the jointing material.

Joints for reinforced concrete pipe shall conform to Section 7 of ASTM C361 except that gaskets shall have a circular cross section and shall be confined in a groove in the pipe spigot. Pipe with collars in lieu of integral bells will not be acceptable.

Joints for PVC pipe shall comply with all recommendations and instructions of the pipe manufacturer.

3009 TEMPORARY PLUGS. Provide and install plugs as manufactured by pipe supplier or as fabricated by contractor of approved construction. Plugs shall be watertight against heads up to 20 feet of water. Secure plugs in place in a manner to facilitate removal when required to connect pipe.

Mechanical plugs, braced with a 4x4 timber wedged against the opposite wall of the manhole, shall be installed at the downstream end (connection with existing line) on all sanitary sewer extension projects under construction and shall be verified by the contractor at the completion of each working day. Also, the open end of the sewer shall be plugged at the end of the work day with a suitable mechanical plug to prevent entry of foreign material until work is resumed.

3010 CONNECTIONS TO EXISTING PIPELINES AND STRUCTURES. Connect pipe to existing structures and pipelines where indicated. Observe pertinent articles of specifications pertaining to joint locations.

Prepare structure by making an opening with at least two (2) inches clearance all around fitting to be inserted. The concrete structure shall be initially cut with a concrete saw in conformance with the method and tolerances shown on city standard drawings. Opening between pipe and manhole wall shall be filled with a mechanical waterstop in such a manner that a watertight condition will result.

Manholes to be built on an existing sewer shall be constructed in such a manner as will not disrupt service of the existing sewer. The manhole base, walls, and invert shall be completed before the top half of the sewer pipe is cut or broken away. Rough edges of the pipe thus exposed shall be covered with expansive grout, in such a manner as to produce a smooth and acceptable finish. Any portion of the existing sewer damaged by the contractor shall be repaired or replaced at no expense to the city.

Connections between different pipe materials shall be made using proprietary transition coupling, unless otherwise specified on the drawings.

3011 TEE BRANCHES AND SADDLES. Tee branches and saddles shall be pitched at 45° and installed at locations designated on the plans. The contractor shall verify that tee branch or saddle locations have been marked in advance of the construction of sewers serving any property which will require sewer service and, if the locations have not been designated, shall stop the sewer construction until the necessary tee branch or saddle locations have been obtained.

Tee branches and saddles shall be installed with the lower lip not more than two (2) inches below the outside top of the pipe. Tee branches or saddles shall not be covered until each location has been recorded.

Each tee branch or saddle shall be marked with a wooden strip extending from the tee vertically to within one (1) foot of the ground surface. Markers shall be securely anchored and maintained vertical until backfilling has been completed. Tee branches or saddles shall be closed with a suitable plug held in place by an approved joint sealing compound.

3012 SERVICE CONNECTIONS. Service connections made to the sewer prior to backfilling shall not be installed as vertical risers but shall be laid on a slope not to exceed one foot vertical to one foot horizontal. A 45° bend shall be used to join the tee branch to the service connection or stub line. The service pipe shall make such a horizontal angle with the sewer line that a proper connection to the 45° bend or stub line is obtained without trimming the pipe and with no danger of jute or jointing material

being forced into the sewer. Each service connection pipe shall have a solid bearing on rock backfill.

3013 CONCRETE ENCASUREMENT. Concrete encasement shall be installed where and as shown on the drawings and where, in the opinion of the engineer, such pipe encasement is necessary because of unforeseen conditions encountered in the work. All pipe which is to be encased shall be suitably supported and blocked in proper position and shall be anchored against flotation. The minimum 28-day compressive strength of concrete used for encasement of sewer lines shall be 3000 psi.

3014 WATER LINE CLEARANCES. Sanitary sewers and water lines shall be constructed a distance of ten (10) feet apart when they are to be installed parallel to each other. Exceptions to this requirement shall be granted only upon written approval by the Kansas Department of Health and Environment.

Where sanitary sewer lines are to be installed over and across water lines, the sewer pipe shall be constructed of ductile iron pipe for a distance of at least ten (10) feet in each direction from the crossing.

Where sanitary sewer lines are to be installed under and across water lines and a two (2) foot clearance cannot be obtained because of limiting grades or grades of existing structures, then the sewer line shall be constructed of ductile iron pipe for a distance of at least ten (10) feet in each direction from the crossing.

3015 SEWER MANHOLES. Manhole construction shall comply with all of the applicable requirements of Section 3100 Sanitary Sewer Manholes.

3016 ACCEPTANCE TEST. Each reach of sewer shall meet the requirements of the following acceptance tests. All defects shall be repaired to the satisfaction of the engineer by and at the expense of the contractor.

- A. Lamping. Gravity sewer lines shall be checked for alignment by lamping and visual inspection after all installations are complete, including all backfill, compaction, and cleaning. The pipe between successive manholes shall not be more than one-fourth (1/4) of the pipe diameter out of alignment.
- B. Infiltration Test. An infiltration test will be required when the sewer line is below the ground water level. The amount of water leaking into the sewer shall

be measured and it shall not be more than 200 gallons per day per mile of pipe, per inch nominal diameter.

- C. Exfiltration Test. In areas where the ground water level is below the pipe, the contractor shall perform an exfiltration test. The section of sewer to be tested shall be filled with water so that the water level in the upstream manhole is at least four (4) feet above the flow line or two (2) feet above the top of the pipe, whichever is greater.

The amount of water added during the test period to maintain the water level shall be measured and it shall not exceed a rate of 200 gallons per day, per mile of pipe, per inch nominal diameter.

- D. Air Test. As an alternate to the exfiltration test, the contractor may perform a low pressure air test when approved by the engineer. The section of pipe between successive manholes shall be sealed with suitable plugs. One of the plugs shall have an orifice through which to pass air into the section of pipe being tested. The air supply line shall have a positive on-off valve and suitable means for readily disconnecting it at the control panel. A second orifice in the plug shall be used for constantly reading the internal pressure of the pipe. This orifice shall be continuously connected to a pressure gauge having a range from 0 to 10 psi. The gauge shall have minimum divisions of 0.10 psi, and shall have an accuracy of ± 0.04 psi. Reinforced concrete pipe shall not be air tested.

Low pressure air testing shall be conducted on all lines unless otherwise directed by the city engineer. The testing methods and air leakage rates shall conform to the requirements of ASTM C828-80 or the latest revision thereof. Each reach of sewer pipe between manholes shall be tested after completion of the installation of the pipe and appurtenances and the backfill of the sewer trench.

Internal air pressure shall be monitored so that it will not exceed 5.0 psig. After reaching 4.0 psig, the air supply shall be maintained at 4.0 psig for at least two (2) minutes in order to allow equilibrium between air temperature and pipe walls. During this time all plugs shall be checked to detect any leakage. If any of the plugs are found to leak, air shall be bled and the plugs retightened prior to resupplying air. After temperature

has stabilized, the pressure is to be maintained at 4.0 psig. Upon reaching a stabilized pressure of 4.0 psig, timing shall begin to determine the time required for the pressure to drop to 3.0 psig. If the time, in seconds, for the air pressure to decrease from 4.0 psig to 3.0 psig is greater than that shown in the following table, the pipe shall be presumed to be free of defects.

Pipe Size	Required Time per 100 LF	Maximum Required Time
8"	70 sec.	227 sec.
10"	110 sec.	283 sec.
12"	158 sec.	340 sec.
15"	248 sec.	425 sec.
18"	356 sec.	510 sec.
21"	485 sec.	595 sec.
24"	634 sec.	680 sec.
27"	765 sec.	765 sec.
30"	851 sec.	851 sec.
33"	935 sec.	935 sec.

If the air test fails to meet the above prescribed requirements, the test shall be repeated as necessary after all leaks and defects have been repaired. Prior to acceptance, all constructed sewer lines shall satisfactorily pass the low pressure air test.

In areas where ground water is known to exist, a one-half inch diameter capped pipe nipple approximately 10 inches long is to be installed through the manhole wall on top of one of the sewer lines entering the manhole. This installation is to be done at the time the sewer line is constructed. Immediately prior to the performance of the line acceptance test, the ground water level shall be determined by removing the pipe cap, blowing air through the pipe nipple into the ground to clear it and then connecting a clear plastic tube to the pipe nipple. The tube shall then be held vertically and a measurement of height in feet of water shall be taken after the water height has stabilized in the tube. The height in feet shall be divided by 2.3 to establish the pounds of pressure to be added to all readings.

All pressure sewage force mains shall have hydrostatic pressure and leakage tests performed prior to acceptance. No pressure sewer line shall be accepted unless passing the prescribed requirements.

All tests shall conform to AWWA C600 procedures as modified herein and shall be applicable to all pressure sewers. The test shall be conducted after line installation and trench backfilling is complete.

The test shall be performed separately in segments between sectionalizing valves and a test plug, or between test plugs. Test segments shall be selected so that adjustable seated valves are isolated for individual checking. The contractor shall furnish and install test plugs at no additional cost to the owner, including all required anchors, braces and other devices to withstand hydrostatic pressure on the lugs. Any damage to public or private property caused by failure of the plugs shall be the responsibility of the contractor. The fill rate of the line shall be limited to the available venting capacity.

The pressure test shall be conducted at 1.5 times the maximum operating pressure determined by the following formula:

$$P_{pt} = 0.650 (OP-GE), \text{ in which}$$

P_{pt} = test pressure in psi at gauge elevation

OP = operating pressure in feet as indicated
for
highest elevation of the hydraulic gradient on
each section of the line.

GE = elevation in feet at center line of gauge.

The test shall be performed satisfactorily prior to
determining leakage.

The leakage test shall be conducted at maximum operating
pressure as determined by the following formula:

$$P_{lt} = 0.433 (OP-GE), \text{ in which}$$

P_{lt} = test pressure in psi at gauge elevation

OP and GE = as in pressure test

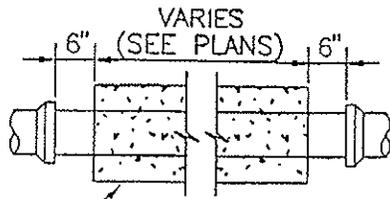
All joints shall be watertight and free from leaks as determined by the test.

If any of the above tests fail to meet the above prescribed requirements, the test shall be repeated as necessary after all leaks and defects have been repaired.

- E. Deflection Test. A deflection test shall be required on all installations involving flexible or semi-rigid pipe after said pipe has been laid and backfilled. The maximum allowable deflection shall not exceed 5.0 percent of the pipe's internal

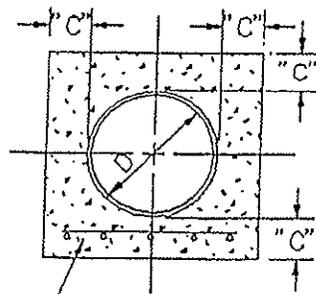
diameter. The deflection test shall consist of guiding a device of the appropriate size for the pipe involved to accurately measure any deflection in the pipe. The device to be used shall be approved by the city engineer prior to its use. Attention is directed to the fact that the pipe's nominal diameter is greater than the actual internal diameter of the pipe. Lamping will not be approved as a substitution for deflection testing.

Upon completion of the testing, all piping showing a deflection greater than 5.0 percent shall be excavated, replaced, backfilled, and retested to the satisfaction of the engineer.

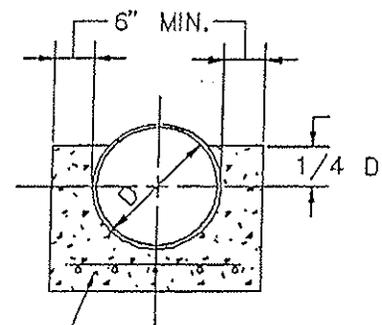


CONCRETE ENCASEMENT

"C" = 6" FOR PIPE 18" & LESS
8" FOR PIPE 21" THRU 36"



STANDARD CONCRETE ENCASEMENT

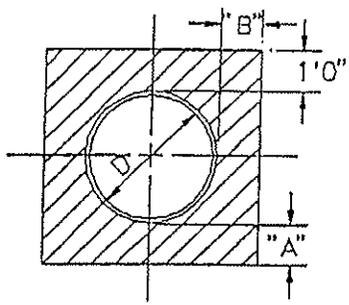


STANDARD CONCRETE EMBEDMENT

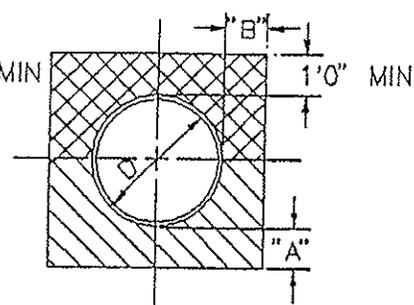
REINFORCING AS DIRECTED BY ENGINEER IN YIELDING SOILS

TYPE	P	LOAD FACTOR
REINFORCED	0.40%	3.5
REINFORCED	1.00%	4.8
PLAIN		2.8

D	ROCK		SOIL	
	A	B	A	B
4" - 18"	6"	6"	4"	6"
21" - 24"	9"	9"	4"	7"
27" - 30"	9"	9"	4"	8"



CLASS "B" BEDDING
(FLEXIBLE OR SEMI-FLEXIBLE PIPE)



CLASS "B" BEDDING
(RIGID PIPE)

- HAND PLACED & HAND TAMPED BACKFILL
- GRANULAR FILL
- CONCRETE

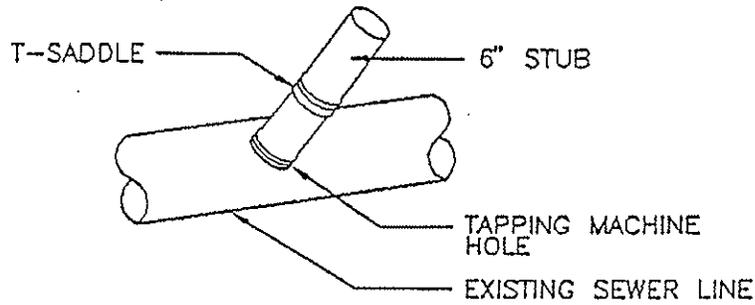
- D NOMINAL PIPE SIZE
- A FILL BELOW PIPE (SEE TABLE)
- B SIDE CLEARANCES (SEE TABLE)
- P AREA TRANSVERSE STEEL EXPRESSED AS A % OF AREA OF CONCRETE AT CROWN

STANDARD EMBEDMENTS

REFER TO TECHNICAL SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS

N.T.S.

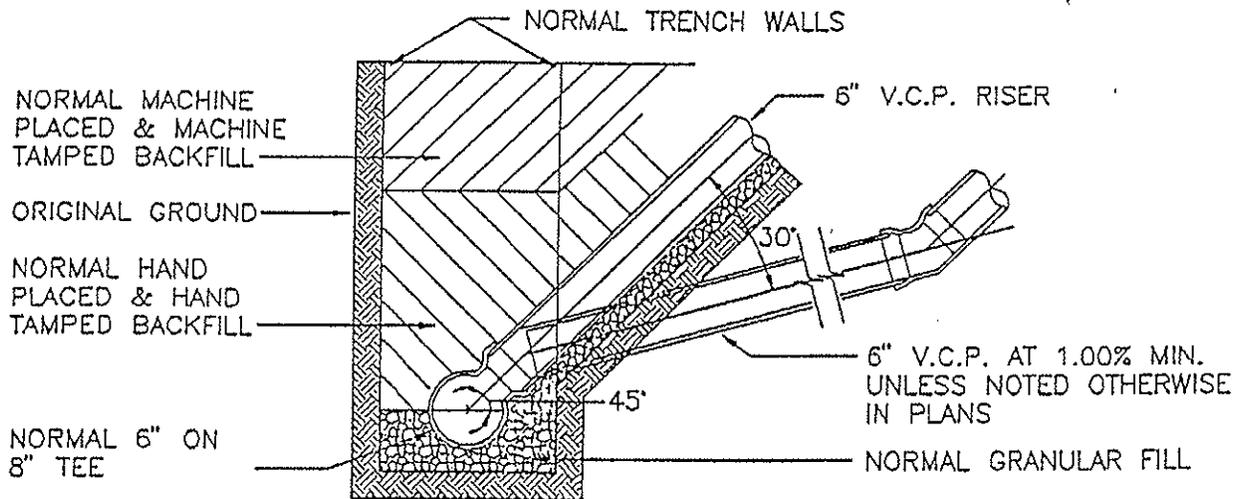
<u>DEPARTMENT of</u> <u>ENGINEERING</u> <u>SERVICES</u>	APPROVED	REVISED	CONCRETE ENCASEMENT, CONCRETE CRADLE, & BEDDING DETAILS	STANDARD
	_____ CITY ENGINEER	_____ 		DETAIL
	_____ DATE	_____ 		SD30-1



SEE WRITTEN SERVICE LINE DESIGN & CONSTRUCTION STANDARDS FOR INSTALLATION PROCEDURES.

SADDLE DETAIL

REFER TO TECHNICAL SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS
N.T.S.



RISER DETAIL

REFER TO TECHNICAL SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS
4" TEES AND SERVICE LINES MAY BE USED - 6" ARE RECOMMENDED
N.T.S.

<u>DEPARTMENT of</u> <u>ENGINEERING</u> <u>SERVICES</u>	APPROVED	REVISED	RISER DETAIL	STANDARD DETAIL
	CITY ENGINEER			SD30-2
	DATE			

SECTION 3100 - SANITARY SEWER MANHOLES

3101 SCOPE. This section covers standard, drop, and special sewer manholes. Manholes shall be constructed complete with covers, steps, fittings, and other appurtenances, in accordance with the details indicated on the drawings.

At the option of the contractor, standard and drop manholes shall be constructed of precast concrete sections or cast-in-place concrete.

Only manholes which are required to have outside pipe and fittings for dropping sewage into the lower line will be designated as drop manholes. Inside drop manholes where the incoming line discharges directly into the manhole and which do not require special fittings will be considered standard manholes.

3102 MATERIALS.

Concrete	Materials, handling, forms, finishing, curing, and other work as specified in Section 2000 Concrete.
Precast Sections	Circular precast concrete; ASTM C478, except as modified. Joints shall be of a bitumastic material or preformed flexible joint sealant applied in accordance with manufacturer's recommendation.
Minimum Thickness	As indicated on the drawings.
Reinforcement	As indicated on the drawings.
Openings	Circular or horseshoe-shaped box-out for each connecting pipe, with surfaces grooved or roughened to improve mortar bond.
Portland Cement ASTM C150	
Sand	Concrete sand (fine aggregate) sieved through 8 mesh screen.
Shrinkage-Correcting Aggregate	Master Builders "Embeco", Sika "Kemox", or Sonneborn "Ferrolith G-DS".
Mortar	One part portland cement Type II, 3 parts sand, 1/4 part hydrated lime, ASTM C-207.

Non-Shrinking Mortar	Premixed or job mixed; job mixed shall be one part shrinkage-correcting aggregate, one part portland cement, one part sand.
Gaskets Mastic	Hamilton-Kent "Kent-Seal No. 2" (minimum two-1" or one-2" beads per joint), or approved equal. Enough material shall be applied to fill the joint so that a minimum of 1/4-inch bead is visible, to be smoothed off after completion.
Flexible Joint	Preformed "O" ring; butylrubber or bituminous polymer are acceptable. Natural rubber is not acceptable
Coal Tar Paint	Koppers "Bitumastic Super-Service Black", Porter "Tarmastic 103", Tnemec "450 Heavy Tnemecol", or approved equal.
Castings	ASTM A48, with asphalt varnish coating applied at the foundry.

3103 STANDARD MANHOLES. All manholes shall be constructed, complete with covers and ladder steps, in accordance with the details shown on the drawings and found herein. Standard manholes above the foundations, unless otherwise required by the plans, shall be constructed of poured-in-place concrete or solid, precast, curved segmental concrete masonry units of circular sections specially cast for use in manhole construction. Manholes shall be constructed with eccentric cones unless otherwise approved by the city engineer.

Foundations for all standard manholes shall have a minimum 28-day compressive strength of 3000 psi.

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

3104 CONSTRUCTION. All mortar shall be used within 40 minutes after mixing. Mortar which has begun to take on initial set shall be discarded and shall not be mixed with additional cement or new mortar.

Manhole inverts shall be constructed of concrete conforming to the requirements of Section 2000 Concrete, with the exception that the concrete shall have a minimum 28-day compressive strength of 3000 psi.

In no case shall the invert section through a manhole be greater than that of the outgoing pipe. The shape of the invert shall conform exactly to the lower half of the pipe it connects. Side branches shall be connected with as large of a radius of curve as practicable. All inverts shall be troweled to a smooth clean surface.

Circular precast sections shall be provided with a mastic gasket or preformed flexible joint to seal joints between sections. The space between connecting pipes and the wall of precast sections shall be completely filled with non-shrinking mortar.

All manholes under construction shall be covered in an appropriate manner to prevent the entry of any stormwater runoff, trench water, sand, earth or any other foreign substances at any time during construction or while the manhole is unattended.

3105 DAMPPROOFING. Surfaces to receive paint shall be dry. Before backfilling is started, the exterior surfaces of precast and poured-in-place manholes shall be painted with two heavy coats of coal tar paint. Application shall be in accordance with the manufacturer's specifications and instructions.

3106 CASTINGS. Manhole rings and covers shall be Clay and Bailey No. 2008 BV, Deeter No. 1315, GCI castings SM2202, or approved equal. The exception shall be for use on shallow manholes where manhole covers shall be Clay & Bailey No. 2020, Deeter No. 2016, GCI castings SM 2100, or approved equal.

When bolt-down type manhole rings and covers are required and specified, Clay and Bailey No. 2014 M, GCI Casting SB 2200STD, or approved equal, with rubber gaskets and stainless steel cover bolts 5/8-inch diameter with hexagonal-head bolts shall be furnished. Bolt-down type manhole rings shall be anchored to the manhole with not less than four (4) 3/4-inch diameter anchor bolts having a minimum of fourteen (14) inches of embedment, except in concrete manholes in which the ring is embedded in concrete.

If castings arrive on the job without a foundry coating, one coat of coal tar paint shall be applied. Before painting, all castings shall be thoroughly cleaned and properly supported. All loose rust shall be removed by wire brushing. Castings shall not be handled until the paint is dry and hard. All castings shall be interchangeable with the Clay and Bailey model numbers.

3107 STUBLINES. Stublines for future connections shall be provided in manholes at the locations indicated on the drawings and shall terminate in a bell and plug.

3108 CONNECTIONS TO MANHOLES. All sewers constructed of rigid pipe extending from manholes shall be encased with concrete to the first pipe joint from the manhole. This support may be deleted if a flexible, watertight gasket, as approved by the city, is used to connect the sewer to the manhole.

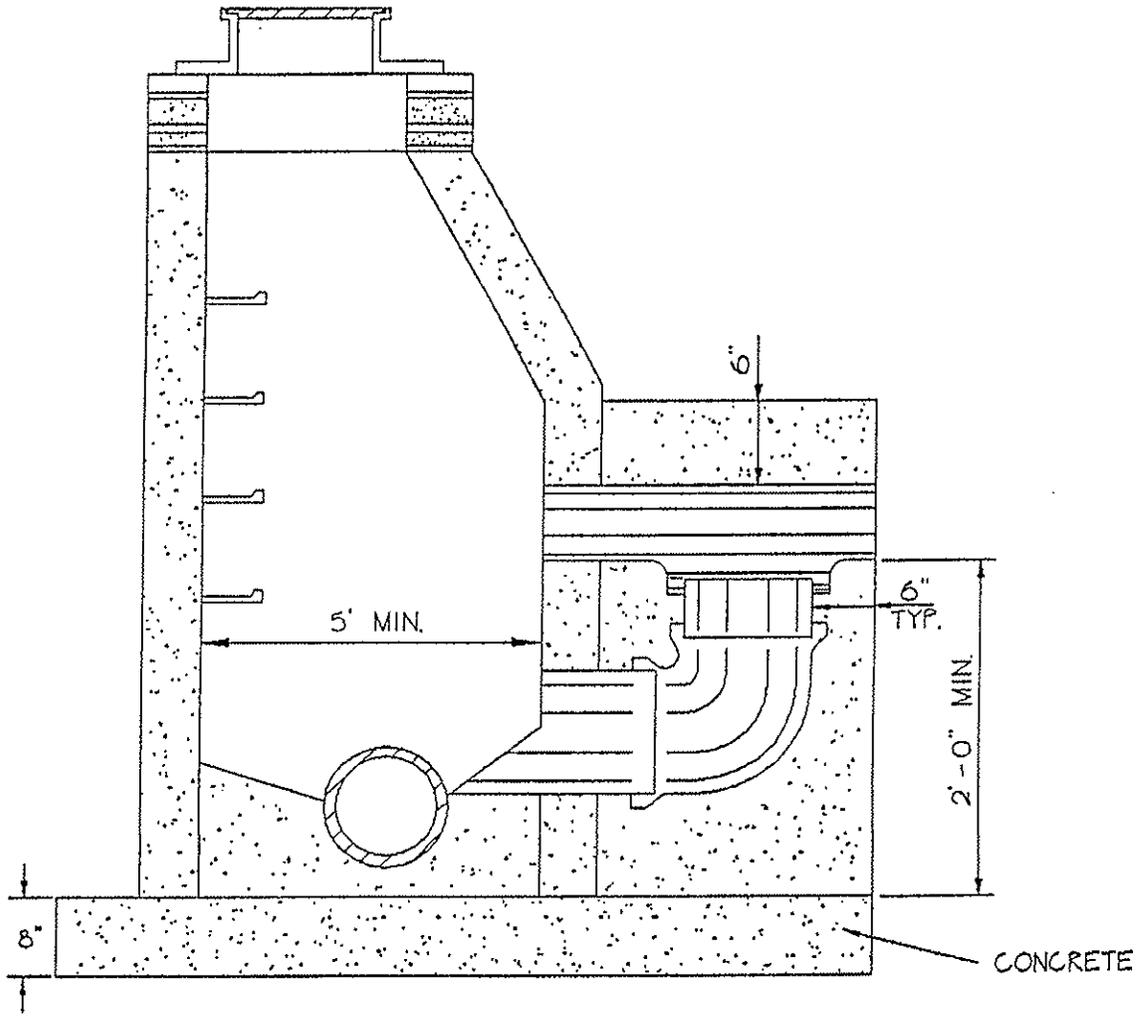
3109 PLASTIC MANHOLE STEPS. Polypropylene coated steel reinforced steps "plastic steps" shall be M.A. Industries, Inc. model PS-2-PF or approved equal manhole step for precast concrete manholes.

3110 GRADE RINGS. All manholes shall be fitted with a six-inch (6") grade ring and a four-inch (4") reducing ring between the cone section and the casting in conformance with detail 31-6.

3111 ACCEPTANCE TESTING Vacuum tests shall be conducted on newly constructed manholes. Vacuum tests shall not be performed on existing manholes that have been repaired or restored or manholes constructed over existing sewers. These manholes shall be tested by visual inspection.

All lift holes shall be plugged with a non-shrinking mortar, as approved by the engineer. The contractor shall plug all pipes connected to the manhole using pneumatic plugs. The pneumatic plugs should be placed into the pipe after the inside surface has been cleaned. Air shall be introduced into the plugs to 25 psig. Bracing can be used to ensure that the plugs are not pulled into the manhole during vacuum testing. After the manhole has been properly prepared, the vacuum tester shall be installed. The test head shall be placed at the inside of the top of the cone section and the compression seal band inflated to 40 psi. The vacuum pump shall be connected to the outlet port with the valve open. The outlet valve shall be closed after a vacuum draw of ten (10) inches of Hg. has been obtained. The test shall pass if the vacuum remains at ten (10) inches Hg. or drops to nine (9) inches Hg. in a time greater than one minute. If the manhole fails, the contractor shall locate the leak and make proper repairs and then re-test.

The manhole vacuum tester shall be as manufactured by P.A. Glazier, Inc. or approved equal. The pneumatic plugs, a part of Cherne Air-Loc Equipment as manufactured by Cherne Industrial of Hopkins, MN., or approved equal. These plugs shall have a sealing strength equal to or greater than the diameter of the connecting pipe to be sealed. A visual inspection will be performed for each manhole by the engineer after the manhole has met the requirements of the vacuum test and is considered in its final state. The inspection shall determine the completeness of the manhole. Any defects identified shall be repaired to the engineer's satisfaction.



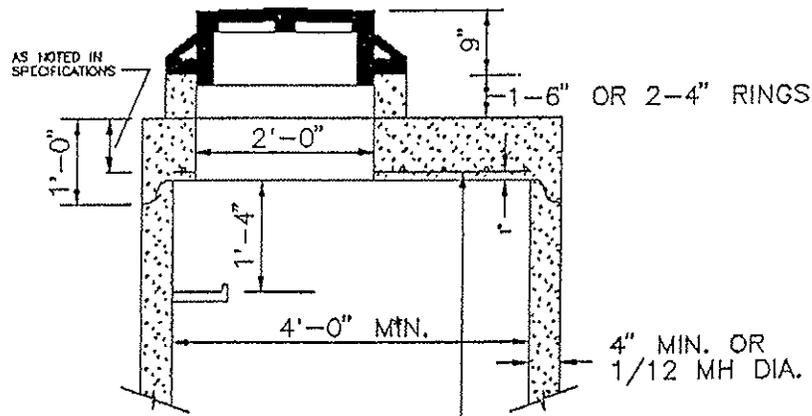
STANDARD DROP MANHOLE

(DROP PIPE TO BE SAME SIZE AS CARRIER)

(REFER TO STANDARD PRECAST MANHOLE DETAIL AND
TECHNICAL SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS)

N.T.S.

<u>DEPARTMENT of</u> <u>ENGINEERING</u> <u>SERVICES</u>	<i>APPROVED</i> <hr/> <i>CITY ENGINEER</i> <hr/> <i>DATE</i>	<i>REVISED</i> <hr/> <hr/> <hr/>	STANDARD DROP MANHOLE DETAIL	<i>STANDARD DETAIL</i> <i>SD31-2</i>
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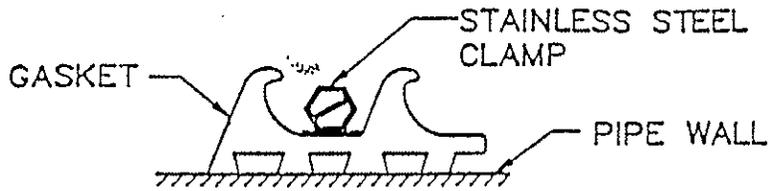


STANDARD PRECAST MANHOLE
(SHALLOW TYPE)

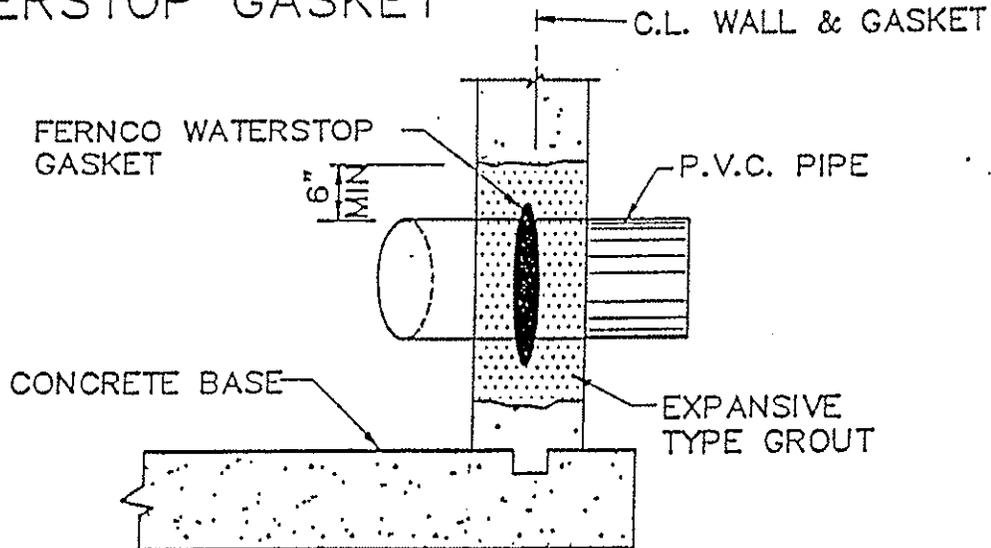
TO BE USED ONLY WHEN
SPECIFIED IN PLANS

REFER TO TECHNICAL SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS
 N.T.S.

<u>DEPARTMENT of</u> <u>ENGINEERING</u> <u>SERVICES</u>	<u>APPROVED</u>	<u>REVISED</u>	STANDARD PRECAST MANHOLE (SHALLOW TYPE)	<u>STANDARD</u> <u>DETAIL</u>
	<u>CITY ENGINEER</u>	<hr/>		<u>SD31-3</u>
	<u>DATE</u>	<hr/>		



WATERSTOP GASKET

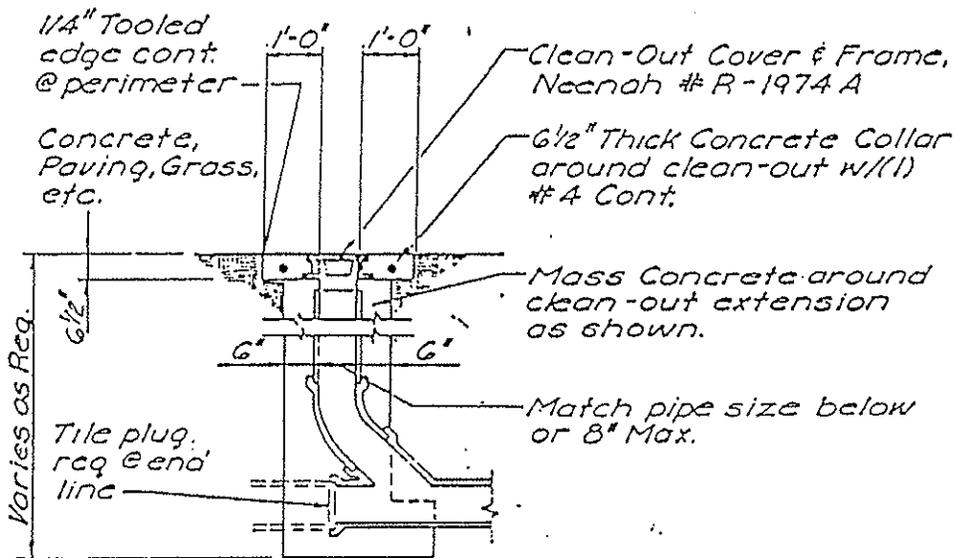


DIMENSION TABLE FOR WATERSTOP GASKET	
NOMINAL PIPE SIZE	GASKET INSIDE DIA.
4	3.8
6	5.7
8	7.8
10	9.9
12	11.9
15	14.7

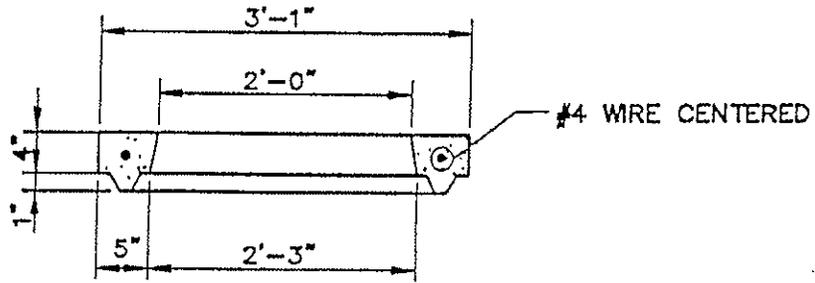
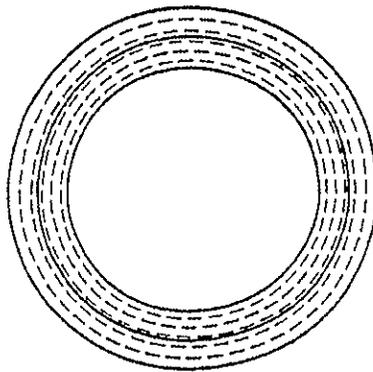
NOTES:

- WATERSTOP GASKET - GASKET CROSS SECTION SHALL BE EQUAL TO HAMILTON KENT DIE NO. 2347, OR A-LOK.
- CLAMP - CLAMPS SHALL BE WORM DRIVE WITH 3/8" HEX HEAD SLOTTED SCREW WITH 9/16" WIDE BAND WHICH IS CONTINUOUSLY GEAR SLOTTED ALL AROUND. CLAMPS SHALL BE ALL STAINLESS STEEL-BAND AND A HOUSING OF 300 SERIES AND WORM SCREW OF 400 SERIES S.S. CLAMPS SHALL BE EQUAL TO IDEAL, 64 SERIES OR 68 SERIES, 0.024" THICK.
- INSTALLATION - STRETCH GASKET AND SLIP OVER PIPE INTO POSITION. PLACE CLAMP OVER GASKET AS SHOWN ABOVE AND TIGHTEN WORM DRIVE TO 10'-LBS. TORQUE. ENCASE IN EXPANSIVE TYPE CEMENT GROUT FOR 4" MIN. COVER ALL AROUND. GROUT SHALL BE A METALLIC ADDITIVE NON-SHRINK TYPE EQUAL TO MASTER BUILDERS "EMBECO"

<u>DEPARTMENT of</u> <u>ENGINEERING</u> <u>SERVICES</u>	APPROVED	REVISED	P.V.C. SEWER PIPE DETAIL	STANDARD DETAIL
	CITY ENGINEER	_____		SD31-4
	DATE	_____		

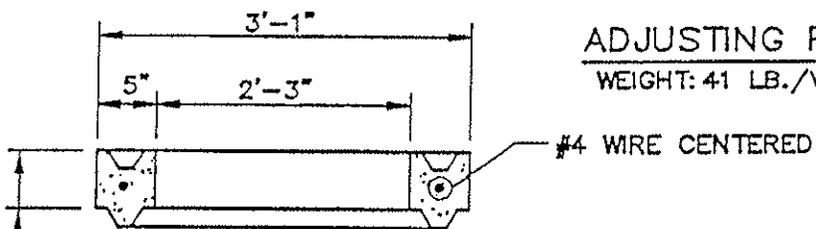
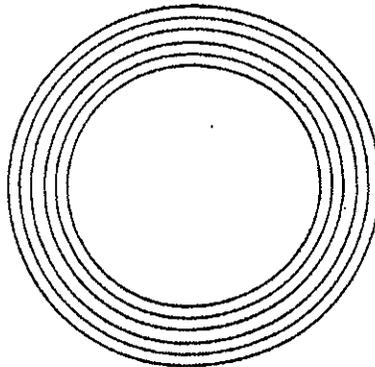


<u>DEPARTMENT of</u> <u>ENGINEERING</u> <u>SERVICES</u>	APPROVED	REVISED	CLEAN OUT DETAIL	STANDARD DETAIL SD31-5
	_____ CITY ENGINEER	_____ _____ _____		
	_____ DATE			



REDUCER RING

WEIGHT: 165 LB.



ADJUSTING RING

WEIGHT: 41 LB./V IN.

STANDARD HEIGHTS
3", 4", 5", 6", 7", 8", 10", 12"

NOTE: GRADE RINGS SHALL MEET REQUIREMENTS OF ASTM DESIGNATION C-478-80 STANDARD SPECIFICATION FOR PRECAST REINFORCED CONCRETE MANHOLE SECTIONS. REINFORCEMENT: #4 WIRE, ASTMA-82. CONCRETE: 4000 P.S.I.

<u>DEPARTMENT of</u> <u>ENGINEERING</u> <u>SERVICES</u>	APPROVED	REVISED	GRADE RINGS	STANDARD DETAIL
	_____ CITY ENGINEER	_____ _____ _____		SD31-6
	_____ DATE			

SECTION 4000 - STORM SEWERS

4001 SCOPE. This section covers the furnishings of all labor, materials, and equipment for the complete installation of storm sewers and appurtenances in accordance with the contract documents.

The work shall consist of the construction of storm sewers for the removal of water from collection points, in accordance with these specifications and in reasonably close conformity with the lines and grades shown on the contract drawings or established by the engineer. Unless otherwise indicated in these specifications, the phrase "Storm Sewer" shall refer to pipe sewers, box culvert sewers, or paved or rock lined channels.

4002 REINFORCED CONCRETE PIPE. All reinforced concrete pipe shall conform to ASTM C76, Class III. This Specification covers reinforced concrete pipe of 15 to 108 inches in diameter and is intended for use in conveyance of storm water and for the construction of culverts.

Installation shall conform to the requirements of Section 6000 Excavation, Trenching, and Backfilling. No pipe culverts shall be placed until the embedment below the proposed reinforced concrete pipe have been approved by the engineer.

4003 CORRUGATED METAL PIPE. Corrugated metal storm sewer pipe shall be furnished with connecting bands, elbows, and fittings. Corrugated metal storm sewer pipe shall have annular ends. The same type of pipe base metal (steel or aluminum) shall be used throughout any individual run or installation of pipe or for pipe extensions. Materials shall conform to the requirements provided in the 1980 edition of the Standard Specifications for State Road and Bridge Construction, Kansas Department of Transportation.

Corrugated metal culvert pipe gauge requirements shall be as listed on the contract drawings and shall have 2-2/3 inch x 1/2 inch corrugations, unless otherwise indicated. In no case shall any pipe be lighter than 16 gauge.

Corrugated metal storm sewer pipe shall be handled in such a manner that it is not chipped, dented, or bent. If in handling the culvert the base metal is exposed in any way, then it shall be rejected or repaired to the satisfaction of the engineer.

The excavation, trenching, and backfilling of corrugated metal pipe storm sewers shall be performed in accordance with the requirements of Section 6000 of these specifications. No pipe culverts shall be placed until the embedment below the pipe has been approved by the engineer.

4004 SMOOTH INTERIOR CORRUGATED POLYETHYLENE PIPE. This specification applies to high-density polyethylene corrugated pipe with an integrally formed smooth interior. This specification is applicable to nominal size 12- to 36-inch diameter. Requirements for test methods, dimensions, and markings are those found in AASHTO Designation M-294 and ASTM F667. Pipe and fittings shall be made of polyethylene compounds, which meet or exceed the requirements of Type III, Category 4 or 5, Grade P33 or P34, Class C per ASTM D-1248 with the applicable requirements defined in ASTM D-1248. Clean rework material may be used.

Minimum parallel plate pipe stiffness values at 5 percent deflection shall be as follows:

<u>Diameter</u>	<u>Pipe Stiffness*</u>	
12"	45 psi	
15"	42 psi	
18"	40 psi	
24"	34 psi	
30"	28 psi	* Per ASTM Test
36"	22 psi	Method D-2412

The pipe and fittings shall be free of foreign inclusion and holes, and visible defects. The ends of the pipe shall be cut squarely and cleanly so as not to adversely effect joining.

The nominal size for the pipe and fittings is based on the nominal inside diameter of the pipe. Corrugated fittings may be either molded or fabricated by the manufacturer. Fittings produced by manufacturers other than the supplier of the pipe shall not be permitted without the approval of the city engineer. Joints shall be made with split couplings, corrugated to match the pipe corrugations, and shall engage a minimum of 4 corrugations. A neoprene gasket shall be utilized with the coupling to provide a soil-tight joint. Installation shall be in accordance with Section 6000 of these specifications. A manufacturer's certifications that the project was manufactured, tested, and supplied in accordance with this specifications shall be furnished.

4005 CATCH BASINS, INLETS, AND JUNCTION BOXES. The methods of excavation and backfilling for catch basins, inlets, and junction boxes shall conform to the requirements of Section 6000 Excavation, Trenching, and Backfilling and Standard Details of these specifications.

Brick masonry catch basins and inlets shall be constructed as shown in the Standard Details of these specifications as specified

herein, and as directed by the engineer. All joints shall be completely filled with brick mortar.

Bricks shall be free from cracks and checks and shall emit a metallic ring when struck with a hammer. All brick shall be a three (3) hole red brick conforming to ASTM C32, Grade MS Specifications.

All mortar used in the construction of brick masonry structures shall consist of four parts sand, one part masonry and one part Portland cement.

Reinforced concrete catch basins and inlets shall conform to the standard concrete inlet drawings and shall be constructed of concrete having a minimum 28-day compressive strength of 4000 psi.

Concrete cover over steel reinforcement shall be not less than 1-1/2 inches for covers and 1-1/2 inches for walls and floors. All exposed concrete shall have smooth steel trowel or brushed finish.

Interiors of structures shall have the forms removed and surface voids filled.

Foundations for all standard catch basins and inlets shall have a minimum 28-day compressive strength of 3000 psi.

The floors of all catch basins, inlets, and junction boxes shall have inverts. Inverts shall be constructed of concrete conforming to the requirements of Section 2000 Concrete, with the exception that the concrete shall have a minimum 28-day compressive strength of Class I 3000 psi.

All catch basins, inlets, pipes, and junction boxes shall be thoroughly 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.

4006 REINFORCED CONCRETE BOX CULVERTS. The work performed herein covers the installation of concrete work in strict accordance with the applicable provisions of Section 2000 Concrete, Section 6000 Excavation, Trenching, and Backfilling, Standard Details, all of these specifications, the 1990 edition of the Standard Specifications for State Road and Bridge Construction, Kansas Department of Transportation, and the applicable contract drawings.

4007 PAVED DITCHES AND RIPRAP Paving concrete for paved ditches shall conform to the applicable provisions of Section 2000 Concrete of these specifications and shall conform to the standard drawings or approved equal.

The concrete shall be placed beginning at the lower end of the portion of the ditch to be lined and progressing toward the upper end. If required on the contract drawings, the concrete shall be reinforced with the type of reinforcement and in the manner indicated. Contraction or construction joints shall be spaced and formed as indicated on the contract drawings.

The surface shall be finished with a wooden float. A light brooming may be required for a more acceptable finish. Immediately after the finishing operations are completed, the concrete shall be protected and cured in conformance with the requirements specified in Section 2000 Concrete.

Riprap shall be placed at the locations and to the dimensions shown on the contract drawings in accordance with the specified requirements.

Riprap shall be graded as necessary to form a dense blanket. The finished surface shall present an even surface conforming to the lines, grades, and sections given. Riprap shall be placed to a minimum depth of eighteen (18) inches.

Riprap shall be placed in such a manner that voids created by larger pieces are filled in by smaller pieces and no voids extend directly through the riprap to the surface below. The riprap shall be placed in rows transversely to the center line of the ditch and in the manner indicated on the drawings. The riprap shall be placed with ends and sides abutting and the joints between rows breaking with the joints in the preceding row.

Riprap shall consist of durable field or quarry stones or sound pieces of concrete that have no protruding steel. Riprap pieces shall range in weight from five (5) pounds to two hundred (200) pounds. Not less than 75 percent shall be within the range of one hundred (100) pounds to two hundred (200) pounds.

Stone for riprap shall be free from earth, soapstone, shale, shale-like or other easily disintegrated material that will tend to decrease the durability of the material after placement.

When grouted stone riprap is indicated the spaces between stones of grouted riprap shall be filled with grout consisting of one (1) part Portland Cement and three (3) parts of fine aggregate with sufficient water to form a plastic mix. The grout shall be poured and broomed into the spaces until they are completely filled.

4008 HEADWALLS, WINGWALLS, ENDWALLS, AND END SECTIONS.
Construction will be according to details in the approved plans. Precast concrete or fabricated metal end sections may be used in

place of cast-in-place concrete structures with the engineer's approval. Shop drawings will be submitted for precast box culvert pieces.

Materials will be in accordance with Section 2000 Concrete and Section 4000 Storm Sewers and Standard Details of this Specification. The same type of pipe base metal (steel or aluminum) shall be used throughout any individual run or installation of pipe or for pipe extension, including end sections.

The end sections for pipe culverts shall be installed in accordance with the requirements specified in Section 6000 of these specifications.

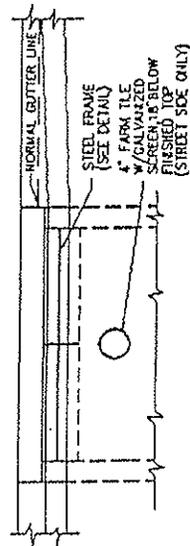
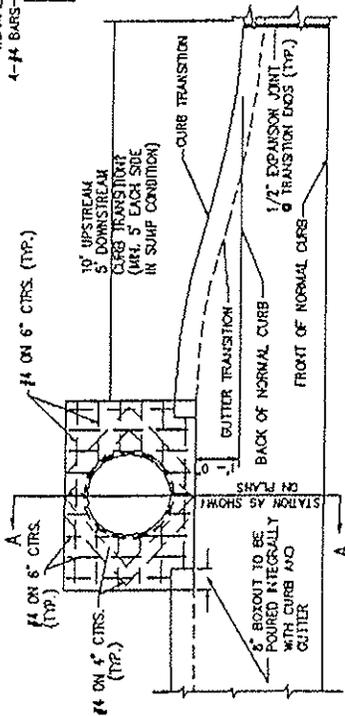
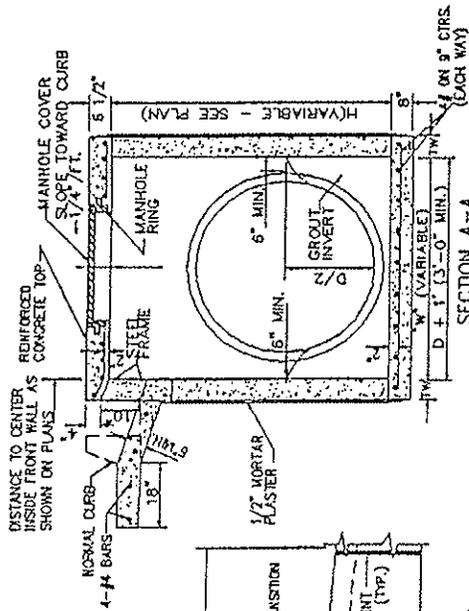
The area excavated for the pipe and headwalls shall be backfilled with suitable material and the material shall be compacted in accordance with the provisions of Section 6000 of these specifications.

4009 RESTORATION OF SURFACE CONSTRUCTION. The restoration of concrete and asphalt pavement, gravel surfacing, walks, drives, curbs, and other surface construction removed or damaged during the progress of the work covered by this section shall conform to the applicable provisions of Section 7000 Restoration of Surface Construction of these specifications.

4010 UNDERDRAINS. In areas that have known subsurface moisture problems, underdrains will be required. They shall be built as shown in Standard Detail 40-9. All projects that are being designed and bid with city funds shall have a line item for 50-100 linear feet of underdrain. This will provide an established unit price for underdrain should it become necessary during a construction.

The plans shall note that the underdrain line items is a contingency item that may not be constructed with the project if it is not necessary. Projects not bid with city funds will not be required to have a contingency underdrain line item.

If during construction it does become apparent that there is a need for underdrain in a location that was not previously designed for underdrain, the city engineer can require that the consultant submit a revised plan including underdrains that will provide for subsurface drainage. The standard detail is a minimum. Upon approval of the city engineer alternate details for increased capacity may be allowed.



NOTES:

1. CONTRACTOR SHALL PROVIDE STEPS SPACED AT 1'-4" O.C. WHERE RILET OR MANHOLE DEPTH IS GREATER THAN 4'-0". STEPS SHALL BE M.A. INDUSTRIES, INC. MODEL PS-2-PF OR APPROVED EQUAL.
2. USE OF PRECAST CONCRETE REQUIRES CITY ENGINEER'S APPROVAL OF SHOP DRAWINGS.
3. MANHOLE RING AND LID SHALL BE CLAY & BAILEY NO. 2020, DEETER 2016 (105 LBS.) OR AN APPROVED EQUAL.
4. SPACER SHALL BE PLACED AT EQUAL INTERVALS ACCORDING TO THE FOLLOWING: L = 1'-0", 2 SPACES; L = 5'-0", 2 SPACES; L = 6'-0", 2 SPACES; L = 7'-0", 2 SPACES; L = 8'-0", 3 SPACES; L = 10'-0", 3 SPACES.
5. THE FIRST DIMENSION IN THE PLAN NOTATIONS REFERS TO THE "W" DIMENSION.
6. THE SECOND DIMENSION IN THE PLAN NOTATIONS REFERS TO THE "D" DIMENSION WHERE APPLICABLE, WITH THE DIMENSIONS, THICKNESSES AND DETAILS SHOWN.
7. ALL METAL SURFACES, AFTER BEING CLEARED OF ALL OIL, GREASE AND WELD SCALE SHALL BE COATED UNIFORMLY WITH ONE COAT OF RLD EPOXY PRIMER NO. 66-1211 AS MANUFACTURED BY THE MFG. CO. INC. THE PRIMER SHALL BE APPLIED TO A DRY FILM THICKNESS OF 4-6 MILS. APPLIED AT THE RATE RECOMMENDED BY THE MANUFACTURER (APPROX. 250 SQ. FT. PER GALLON).
8. CURB CONTRACTOR SHALL HAND FORM AND FINISH GUTTER WITHIN THE INLET THROAT TO THE REAR OF FRONT INLET WALL AT THE TIME THE FINISHING OF NORMAL CURB IS ACCOMPLISHED.
9. THE INVERT SHALL HAVE A TROWEL FINISH TO SECURE SMOOTH INVERT SLOPING TO OUTLET PIPE.
10. OUTLET OR INLET PIPE SHALL BE PLACED AS SPECIFIED OR AS DIRECTED BY THE ENGINEER. REINFORCING STEEL SHALL BE BENT AROUND PIPE.
11. USE CLASS II 4000 PSI CONCRETE FOR ALL STANDARD CATCH BASINS AND INLETS.
12. STORM SEWER PIPE SHALL BE CUT FLUSH WITH INSIDE WALLS OF INLET.

PLAN VIEW

FRONT ELEVATION

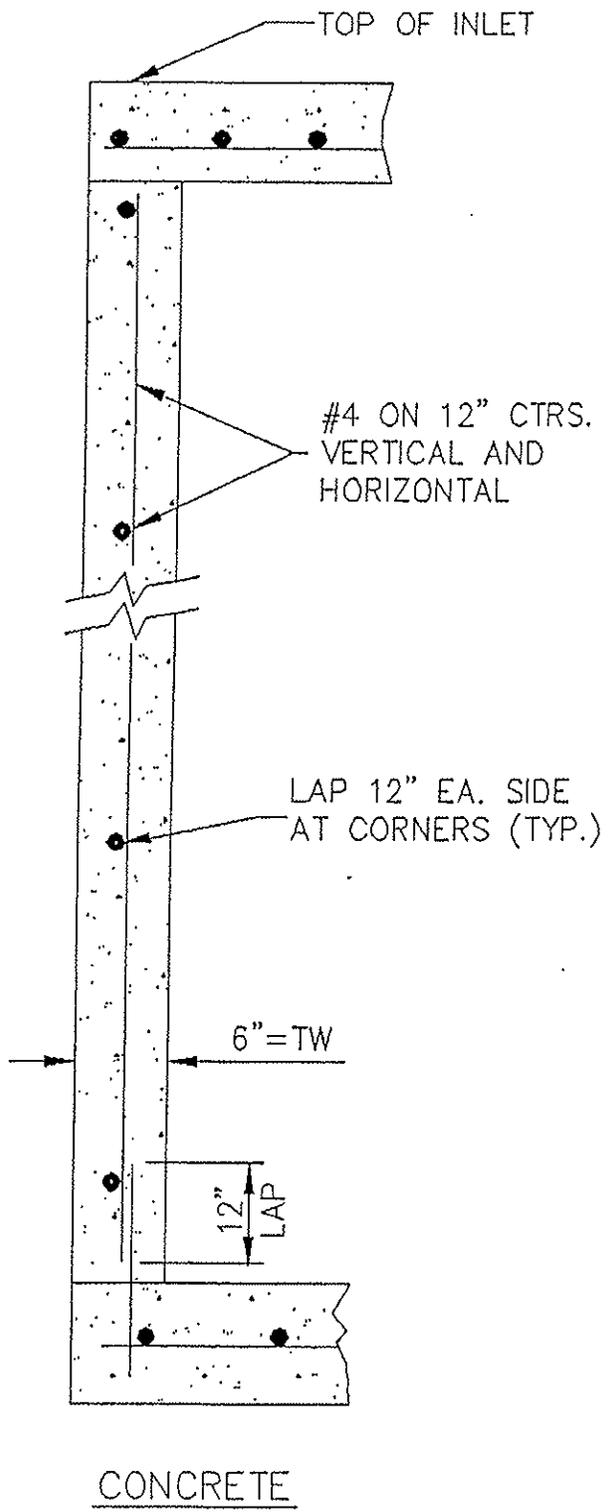
DEPARTMENT of
ENGINEERING
SERVICES

APPROVED
CITY ENGINEER
DATE

REVISED

STANDARD CURB INLET

STANDARD
DETAIL
SD40-1



CONCRETE

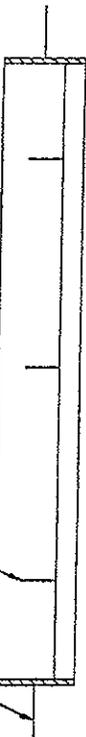
<u>DEPARTMENT of</u> <u>ENGINEERING</u> <u>SERVICES</u>	APPROVED _____ CITY ENGINEER	REVISED _____ _____ _____	WALL SECTION (PRE-CAST OR CAST IN PLACE CONCRETE)	STANDARD DETAIL SD40-2
	_____ DATE			

NOTES:

1. All metal surfaces are to be cleaned of all dust, mill scale and weld scale and shall be coated uniformly with one (1) coat of Douglas No. 6776 Red Oxide Iron Primer applied at a rate of approximately 260 s.f. per gallon.
2. All welds are 3/16" Fillet Weld

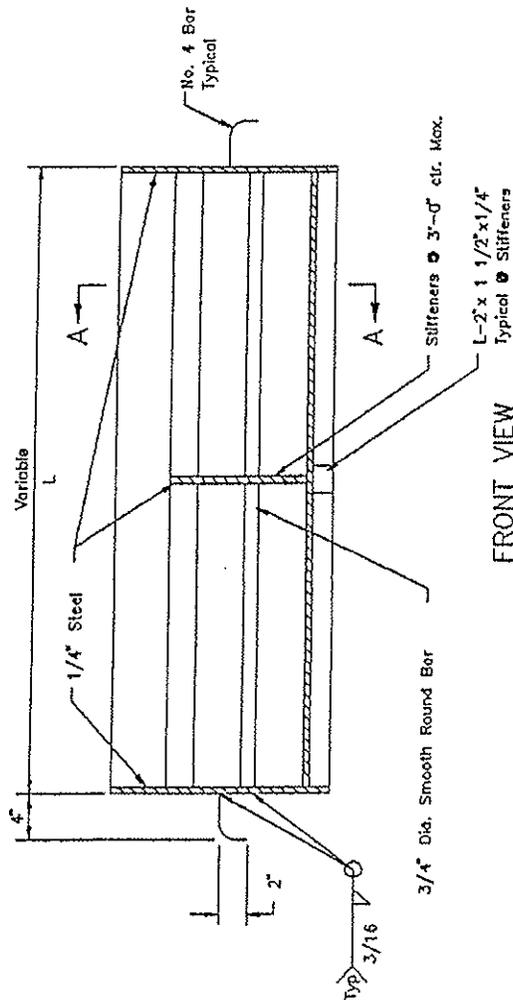
Concrete Curb Dowels (No. 4 Bars) shall be centered Vertically & Horizontally

Concrete Top Slab (No. 4 Bars) @ 1'-0" centers Max.

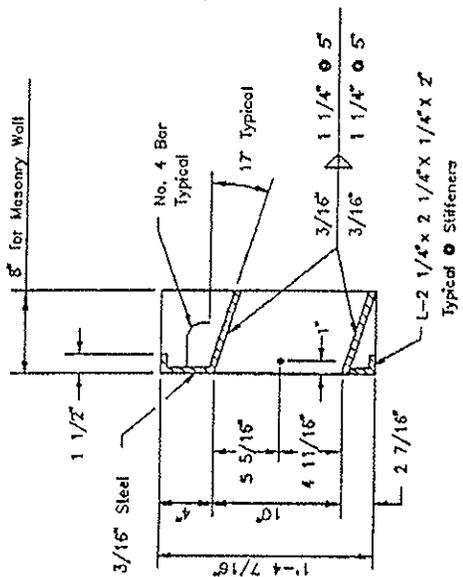


TOP VIEW

Scale: 1 1/2" = 1'-0"



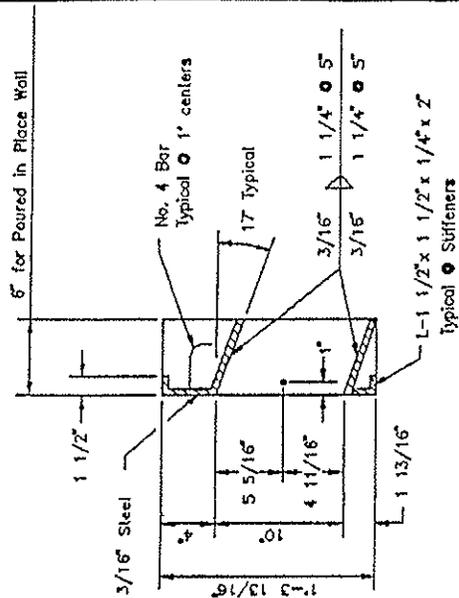
FRONT VIEW



SECTION A-A

8" CONCRETE WALL

Scale: 1 1/2" = 1'-0"



SECTION A-A

6" CONCRETE WALL

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APPROVED

CITY ENGINEER

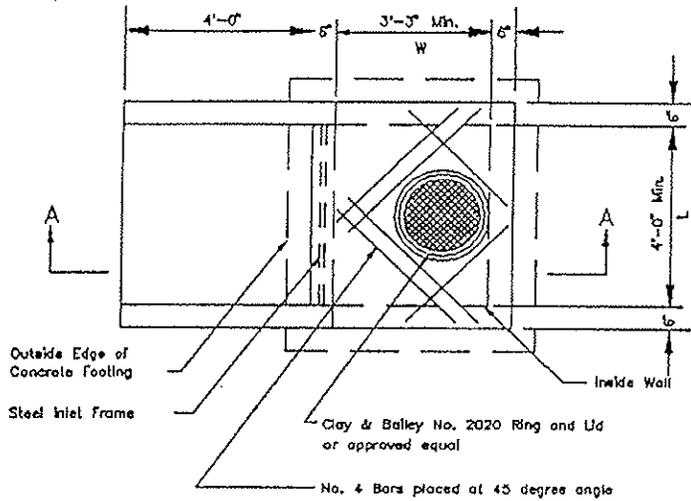
DATE

REVISED

STEEL INLET FRAME
DETAIL

STANDARD
DETAIL

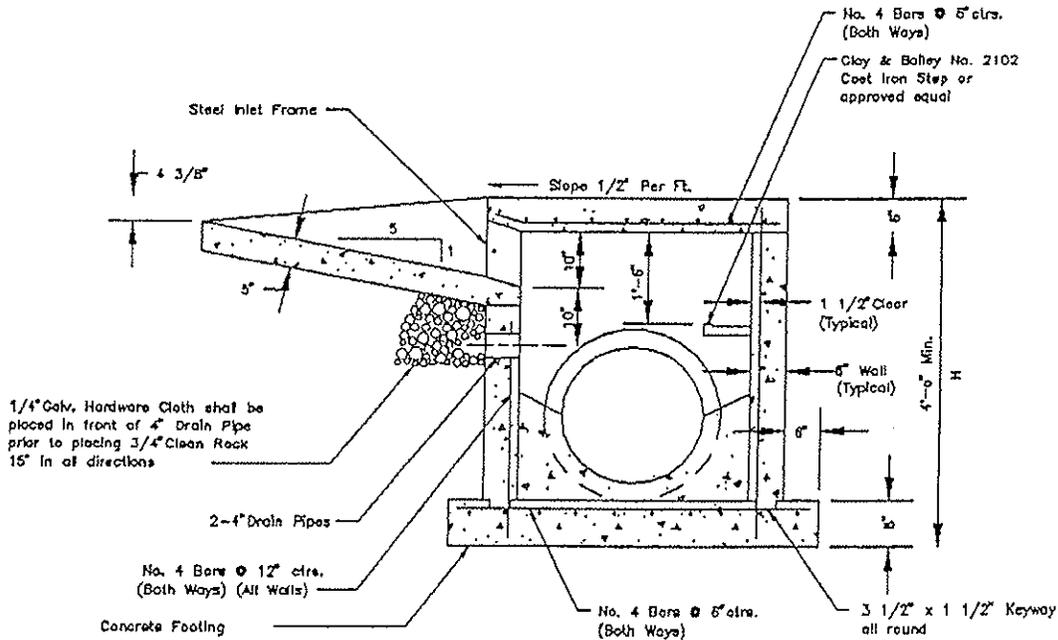
SD40-3



PLAN

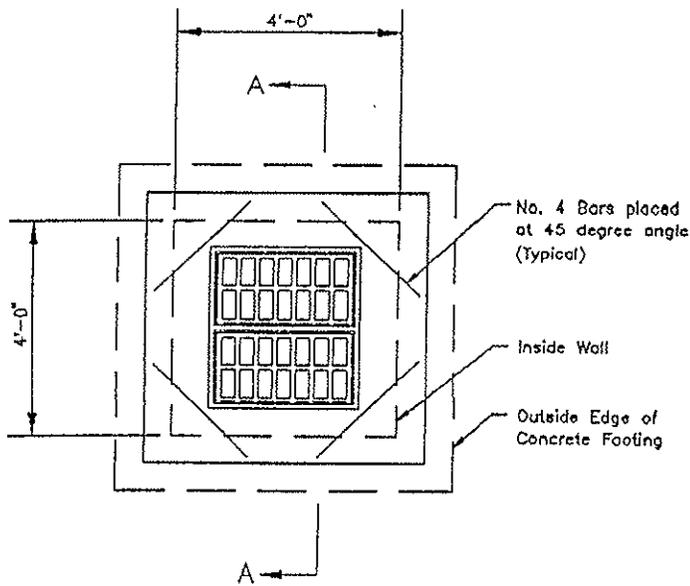
NOTES:

1. Use Class "A" Concrete (AE) throughout (4000 PSI).
2. The First Dimension listed in the Construction Notes is the "L" Dimension. The Second Dimension is the "W" Dimension.
3. Floor of inlet shall be sloped with Non-Reinforced Class "A" Concrete (AE) invert to provide Smooth Flow.
4. Steel Inlet Frame Spacers shall be placed at Equal Spacings not to exceed 4'-0".
5. Cast Iron Steps shall be spaced at 1'-4" O.C. Vertically.
6. Bevel all Exposed Edges with 3/4" Triangular Moulding.
7. Walls may either be poured in place or pre-cast.
8. All Crushed Stone used as Aggregate for Concrete Construction shall be obtained from Quarries and Beds designated by the Kansas Department of Transportation as meeting Durability Requirements of Class 1 or Class 8, as shown on file in the office of the City Engineer.



SECTION A-A

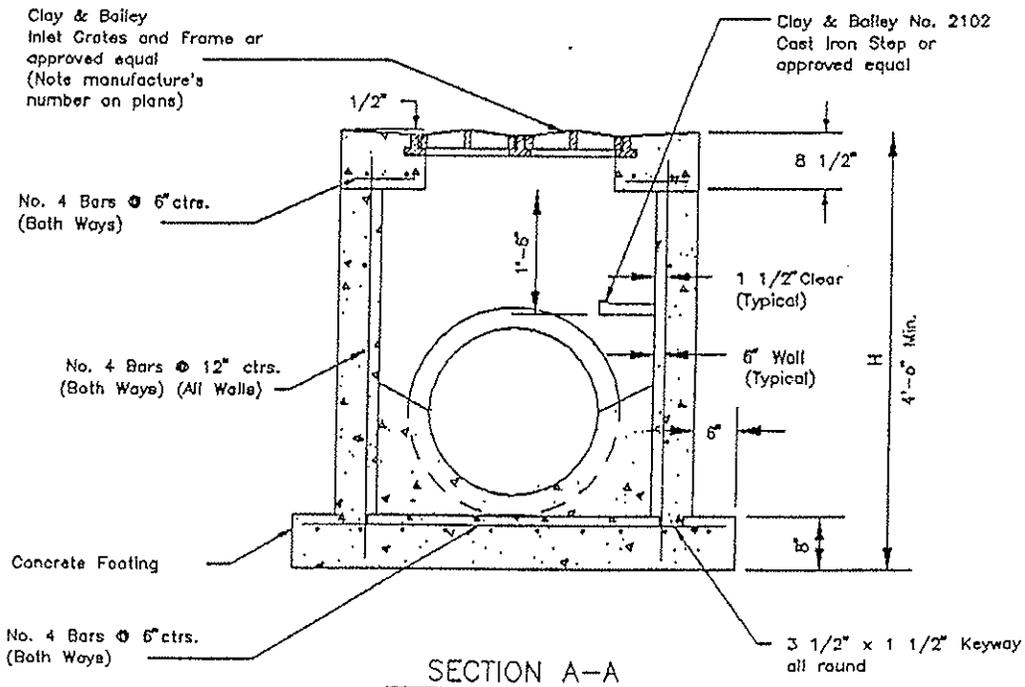
DEPARTMENT of ENGINEERING SERVICES	APPROVED	REVISED	STANDARD DETAIL SD40-4
	_____ CITY ENGINEER	_____ _____ _____ _____	
	_____ DATE	_____ _____ _____ _____	
	AREA INLET DETAIL		



PLAN

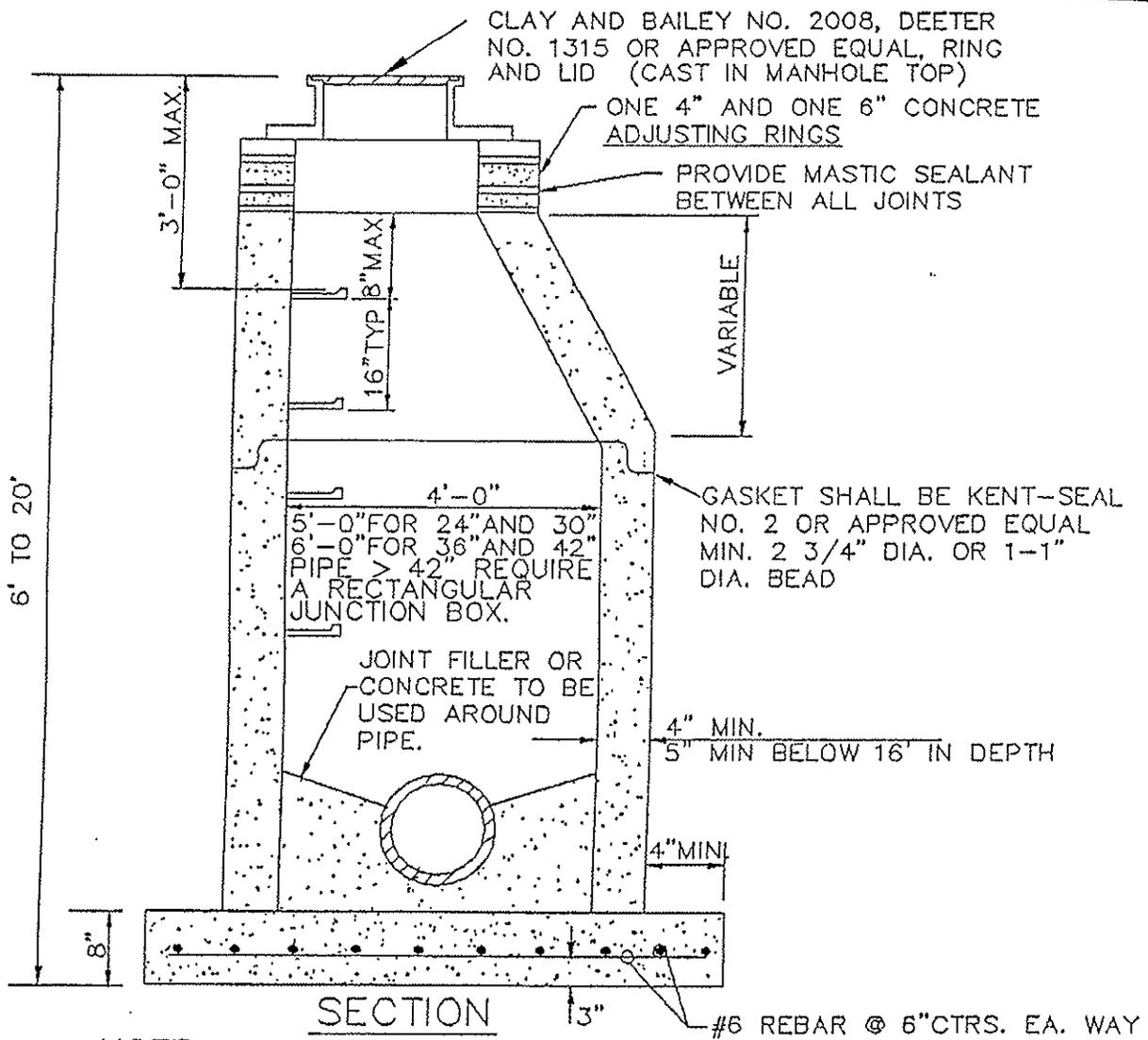
NOTES:

1. Use Class "A" Concrete (AE) throughout (4000 PSI).
2. Floor of Inlet shall be shaped with Non-Reinforced Class "A" Concrete (AE) Invert to provide Smooth Flow
3. Cast Iron Steps shall be spaced at 1'-4" O.C. Vertically
4. Bevel all Exposed Edges with 3/4" Triangular Moulding.
5. Walls may either be poured in place or pre-cast.
6. All Crushed Stone used as Aggregate for Concrete Construction shall be obtained from Quarries and Beds designated by the Kansas Department of Transportation as meeting Durability Requirements of Class 1 or Class 6, as shown on file in the office of the City Engineer.



SECTION A-A

DEPARTMENT OF ENGINEERING SERVICES	APPROVED	REVISED	STANDARD DETAIL SD40-5
	CITY ENGINEER	_____	
	DATE	_____	
	GRATE INLET DETAIL		



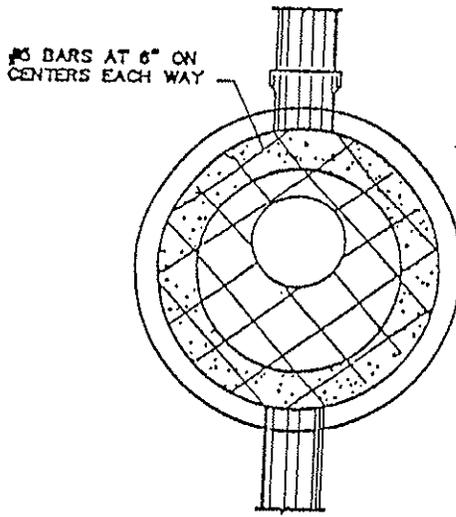
NOTE:

1. PRECAST CONCRETE MANHOLES SHALL CONFORM TO ASTM C478 EXCEPT AS MODIFIED BY THE SPECIFICATIONS.
2. BASES NOT BUILT MONOLITHIC WITH BOTTOM SECTION SHALL BE POURED OF CLASS 1 3000 PSI CONCRETE.
3. MANHOLE MAY BE TRANSITIONED TO 4'-0" DIA., 8' ABOVE F.L. OF OUTFALL FOR 5'-0" AND 6'-0" MANHOLES.
4. THE BOTTOM SECTION OF ALL PRECAST MANHOLES NOT BUILT MONOLITHIC WITH THE BASE SHALL BE SET INTO A STEEL REINFORCED POURED CONCRETE BASE A MINIMUM OF 4". (#4 @ 5" E.W.)
5. THE COMPRESSIVE STRENGTH OF CONCRETE USED IN THE CONSTRUCTION OR PRECAST REINFORCED CONCRETE MANHOLES SHALL NOT BE LESS THAN 4000 PSI.
6. ONLY ECCENTRIC MANHOLE CONES WILL BE ALLOWED UNLESS OTHERWISE APPROVED BY THE CITY ENGINEER.

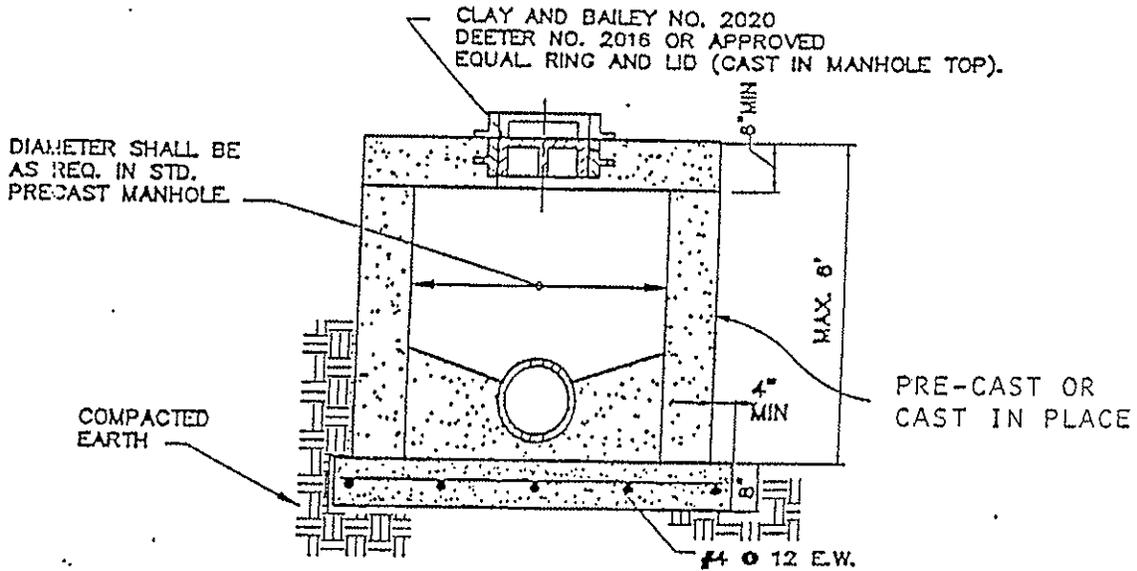
DEPARTMENT of ENGINEERING SERVICES	APPROVED	REVISED	STANDARD STORM SEWER MANHOLE	STANDARD DETAIL
	_____ CITY ENGINEER	_____ _____ _____		SD40-6
	_____ DATE			

NOTES:

1. POINTS OF ATTACHMENT PROVIDED FOR LIFTING PRECAST TOPS SHALL NOT BE LOCATED ON THE TOP SIDE OF INLET TOP.
2. USE OF A STANDARD LID AND RING WILL BE ALLOWED WHERE GRADE PERMITS. (SEE SPEC. FOR APPROVED TYPES)
3. CONTRACTOR SHALL PROVIDE STEPS SPACED AT 1'-4" O.C. WHERE INLET OR MANHOLE DEPTH IS GREATER THAN 4'-0". STEPS SHALL BE M.A. INDUSTRIES, INC. MODEL PS-2-PF OR APPROVED EQUAL

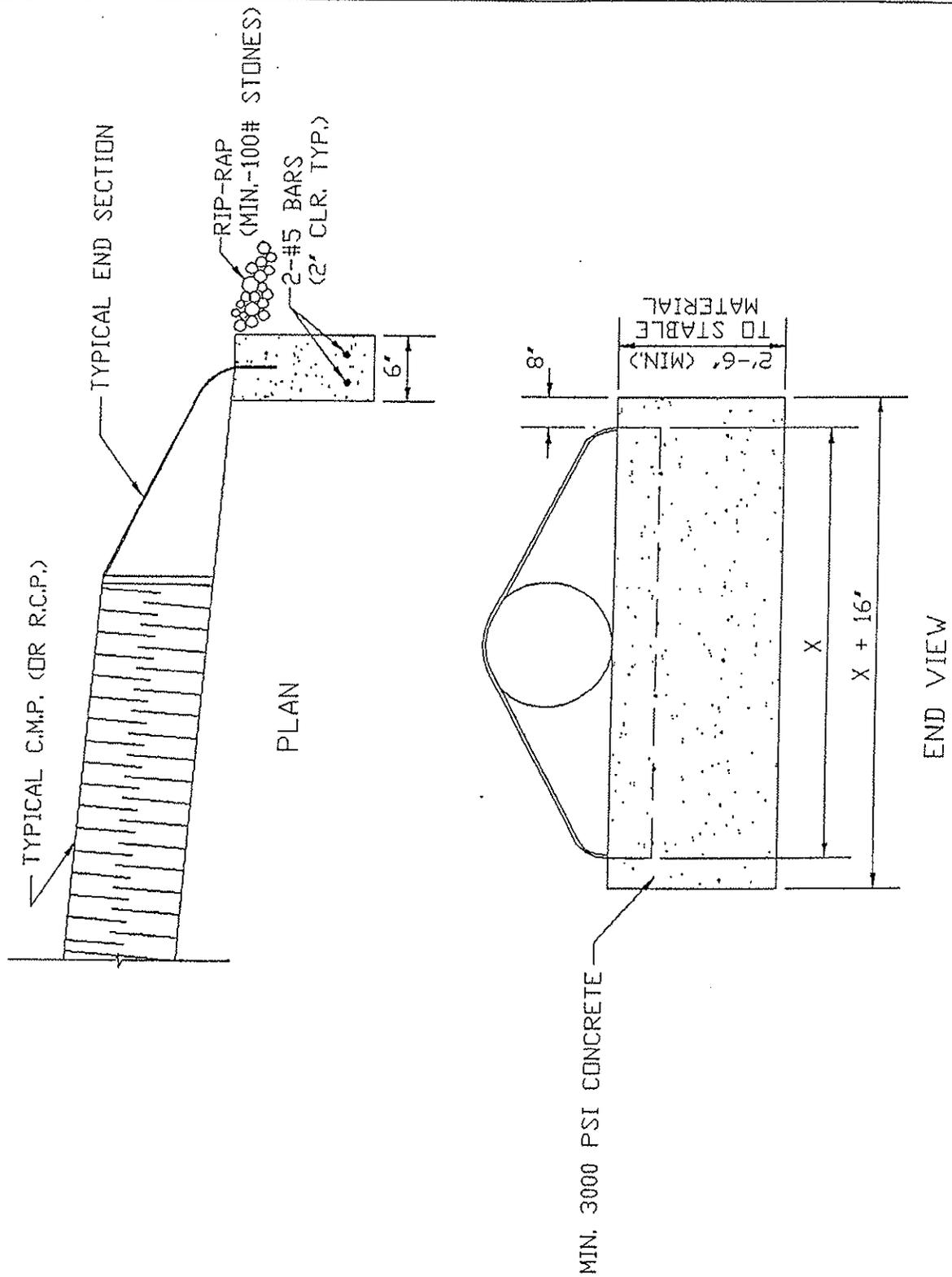


PLAN



SECTION

DEPARTMENT OF ENGINEERING SERVICES	APPROVED	REVISED	SHALLOW JUNCTION BOX DETAIL	STANDARD DETAIL
	_____ CITY ENGINEER	_____ _____ _____ _____		SD40-7
	_____ DATE			

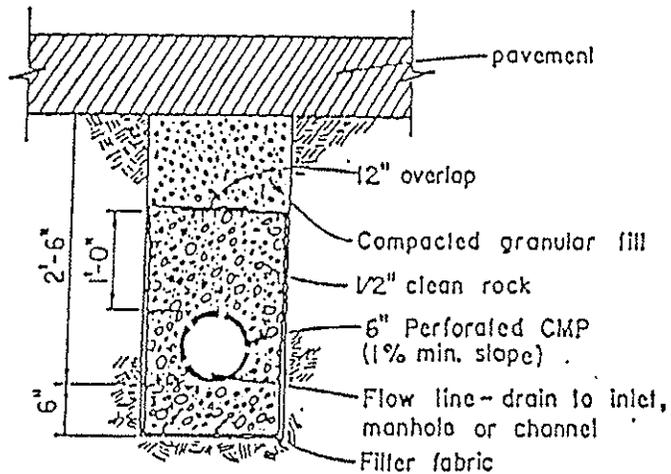


DEPARTMENT of
ENGINEERING
SERVICES

APPROVED	REVISED
_____	_____
CITY ENGINEER	_____
_____	_____
DATE	_____

TYPICAL END SECTION
DETAIL

STANDARD
DETAIL
SD40-8



UNDERDRAIN DETAIL

NOTES:

1. GRANULAR FILL TO BE CRUSHED STONE OR PEA GRAVEL WITH NOT LESS THAN 95% PASSING 1/2" AND NOT LESS THAN 95% TO BE RETAINED ON A #4. FILL TO BE PLACED IN NOT MORE THAN 6" LAYERS AND COMPACTED.
2. FILTER FABRIC TO BE MIRAFI 140N OR EQUIVALENT.

<p>LANSING, KANSAS <u>DEPARTMENT of</u> <u>ENGINEERING</u> <u>SERVICES</u></p>	<p>APPROVED</p> <hr/> <p>CITY ENGINEER</p> <hr/> <p>DATE</p>	<p>REVISED</p> <hr/> <hr/> <hr/>	<p>UNDERDRAIN</p>	<p>STANDARD DETAIL</p> <p>SD40-9</p>
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