

June, 2020

TO: All holders of Wastewater Standard Details

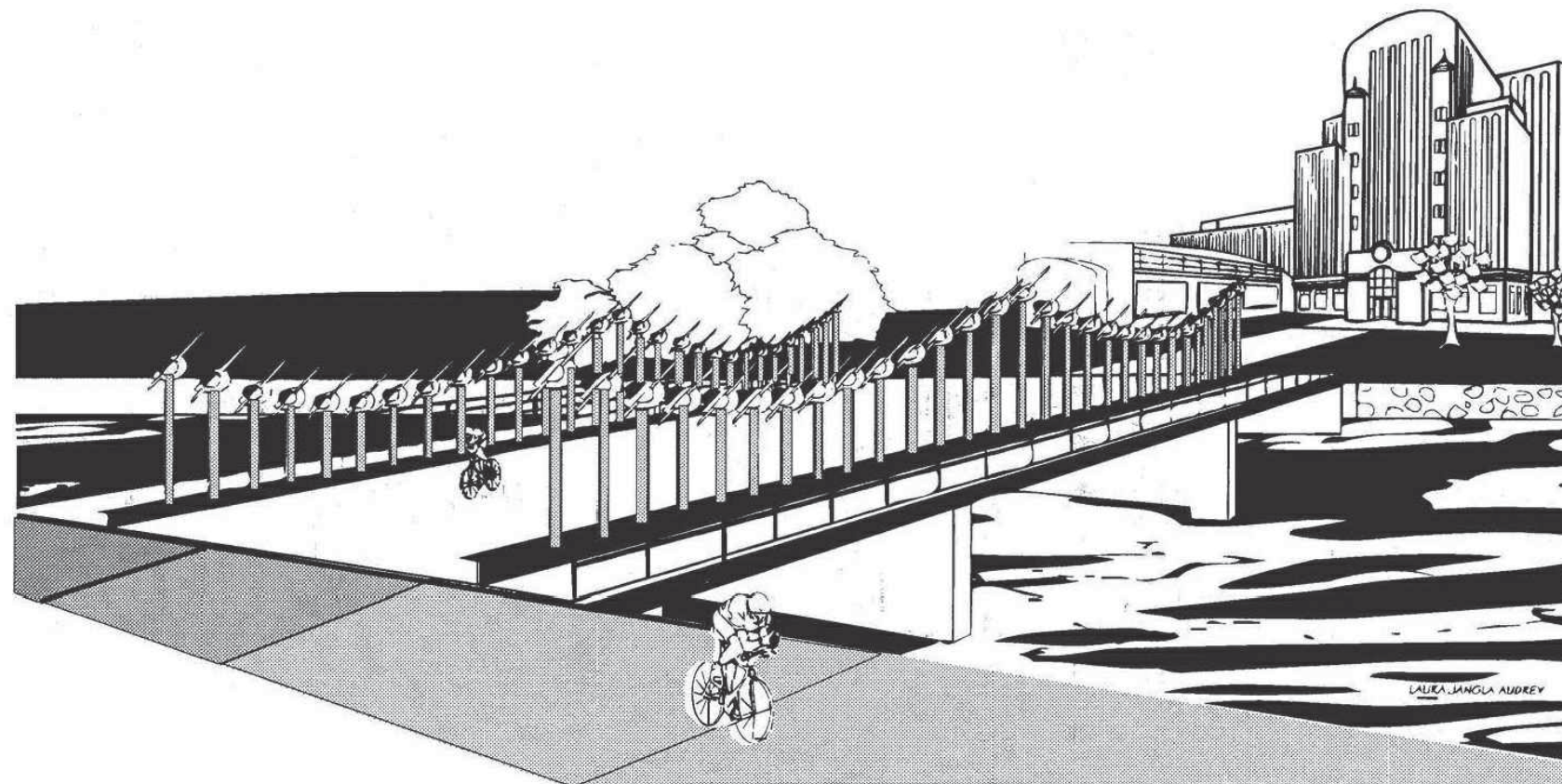
SUBJECT: Revisions to Wastewater Standard Details

The attached Wastewater Standard Details drawings were revised to reflect current standard construction methods, practices and procedures, and details were cleaned up to remove conflicting information, and for better clarity. Materials were not reviewed, vetted, or revised as a part of these revisions. Future revisions may include structural and material updates.

The most prominent, and only structural update in this set of revisions was to the inlet details. The original details were only to be used for inlets up to 6 feet deep, and were limited in length to a single, double or triple Number 16 inlet, or 6', 9' or 12' for Number 14 inlets. The new inlet details are applicable for inlets up to 12 feet deep, and up to 75 feet long.

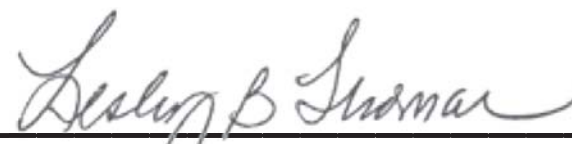
The attached Standard Details are to be used for all storm and sanitary sewer construction done under the jurisdiction of the City and County of Denver, Department Transportation and Infrastructure. These standards are to be used in conjunction with the technical specifications and the established ordinances of the City and County of Denver and in case of conflict, the technical specifications which are to be used in conjunction with these standards shall govern.

These drawings may be updated from time to time and the user is responsible for obtaining updated or revised standards. The City shall not be held liable for use of outdated standards by the contractor, consultant, developer, or engineer.



CITY AND COUNTY OF DENVER WASTEWATER STANDARD DETAILS

APPROVED BY:



CITY ENGINEER

JUNE 2020



DENVER
THE MILE HIGH CITY

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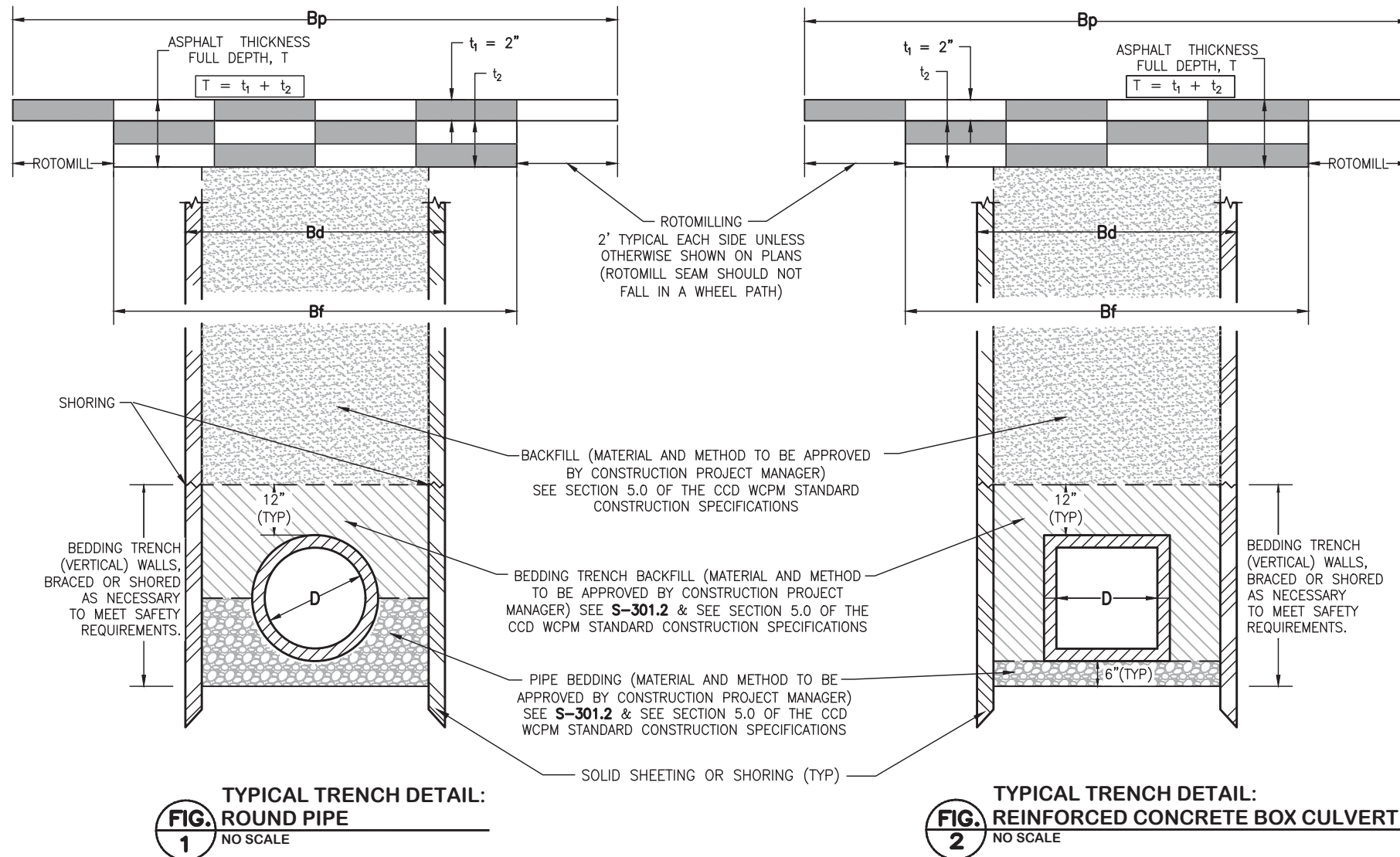


FIG. 1 TYPICAL TRENCH DETAIL: ROUND PIPE
NO SCALE

FIG. 2 TYPICAL TRENCH DETAIL: REINFORCED CONCRETE BOX CULVERT
NO SCALE

PAY ITEM NOTES:

- P1. Bp = PAY WIDTH FOR PAY ITEM 20-2 ASPHALT SURFACE COURSE PAYMENT=SY PER INCH THICKNESS (2" MIN THICKNESS) WIDTH AS SHOWN IN TABLE UNLESS OTHERWISE SHOWN ON PLANS.
- P2. Bf = PAY WIDTH FOR AY ITEM 20-3 ASPHALT BASE COURSE PAYMENT=SY PER INCH THICKNESS (t₂) WIDTH AS SHOWN IN TABLE UNLESS OTHERWISE SHOWN ON PLANS.
- P3. SEE PAY ITEM 20-4 FOR ROTOMILLING. ROTOMILLING WILL BE PAID FOR THE 2' EACH SIDE OF Bf BEFORE PLACEMENT OF THE 2" ASPHALT SURFACE COURSE PAY ITEM 20-2. ROTOMILLING FOR THE MAINLINE AND LATERAL TRENCH EXTENTS (Bf) SHALL BE INCLUDED IN THE PRICE OF PIPE.
- P4. PAYMENT WILL NOT BE MADE FOR EXCAVATION OUTSIDE OF THE LIMITS SHOWN ABOVE DUE TO SLOPING OR BENCHING TRENCH, OR OTHER CONSTRUCTIONS MEANS OR METHODS.
- P5. UNLESS OTHERWISE SPECIFIED ON THE PLANS, NO PAYMENT WILL BE MADE FOR REMOVAL, REPLACEMENT, OR RELOCATION OF CURB AND GUTTER, UTILITIES, SIDEWALK, STRUCTURES, ETC. OUTSIDE THE MAXIMUM LIMITS OF EXCAVATION.

GENERAL TRENCHING NOTES:

- 1.1 IN GENERAL, REPLACEMENT QUANTITIES FOR PAVEMENT, SIDEWALK REMOVALS, ETC. ARE DETERMINED FROM THE MAXIMUM PAY WIDTH DIMENSION "Bp". THE ACTUAL FIELD TRENCH WIDTH MAY VARY. THE CONTRACTOR SHALL CONFORM TO ALL INDUSTRY AND OSHA SAFETY CRITERIA GOVERNING EXCAVATION AND PIPELINE CONSTRUCTION.
- 1.2 TRENCH SHALL BE BRACED AND SHORED AS NECESSARY TO AFFORD SAFE WORKING CONDITIONS AND TO PROTECT ADJACENT UTILITIES, STRUCTURES, ETC.. SUFFICIENT BACKFILL SHALL BE IN PLACE BEFORE SHORING IS COMPLETELY REMOVED.
- 1.3 t₁ AND t₂ SHALL BE DETERMINED BY THE DESIGN ENGINEER. ALL ASPHALT QUANTITIES ARE PAID FOR ON A SQUARE YARD PER INCH DEPTH BASIS.
- 1.4 SLOPING, OR BENCHING OF THE TRENCH SIDE WALLS WHERE PERMITTED, SHALL BE IN ACCORDANCE WITH APPLICABLE FEDERAL, STATE, LOCAL, AND OSHA SAFETY REGULATIONS.
- 1.5 AREA FOR STREET CUT PERMIT SHALL BE Bp +12" EACH SIDE OF TRENCH I.E. Bp "PLUS" TWO FOOT TOTAL.
- 1.6 DESIGN ENGINEER TO SPECIFY WHEN FILTER FABRIC IS NECESSARY BETWEEN EXISTING SUBGRADE AND GRANULAR BACKFILL. REFER TO CURRENT MGPEC PAVEMENT DESIGN STANDARDS 2019 (SECTION 4.2.4B) ON PIPING AND PERMEABILITY CRITERIA. (USE GRANULAR BACKFILL IN THIS DETAIL AS THE MSB IN MGPEC. REFER TO MGPEC.ORG.)

TABLE 1. Bd,Bf,Bp VALUES

D	Bd (ft)	Bf (ft)	Bp (ft)
4"-6"	3.5	8.0	12.0
8"-10"	4.0	8.0	12.0
12"-15"	4.5	8.0	12.0
18"-21"	5.0	8.0	12.0
24"	5.5	8.0	12.0
27"-30"	6.0	8.0	12.0
33"	6.5	8.0	12.0
36"-42"	9.0	11.0	15.0
48"	10.0	12.0	16.0
54"	10.5	12.5	16.5
60"	11.0	13.0	17.0
66"	11.5	13.5	17.5
72"-78"	12.5	14.5	18.5
84"	13.5	15.5	19.5
90"	14.0	16.0	20.0
96"	14.5	16.5	20.5
102"	15.0	17.0	21.0
108"	16.0	18.0	22.0
120"	18.0	20.0	24.0
144"	20.0	22.0	26.0
14'	23.0	25.0	29.0

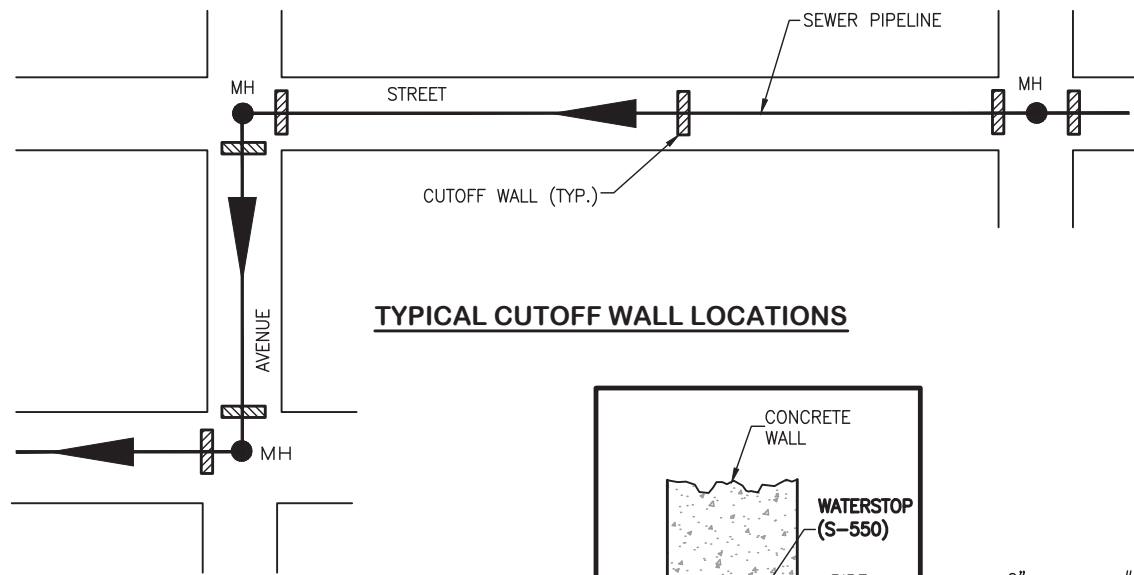
TABLE 1 NOTES:

- i. DOES NOT APPLY TO PRIVATE DETENTION SYSTEMS.
- ii. WHEN SHORING IS NOT APPLICABLE, MINIMUM TRENCH WIDTH SHALL BE 1' FROM OUTSIDE OF PIPE ON EITHER SIDE OF TRENCH.

LEGEND

- Bd= TRENCH WIDTH, INCLUDING SHORING
- Bf= WIDTH OF FULL DEPTH ASPHALT PAVEMENT
- Bp= WIDTH OF ASPHALT SURFACE COURSE
- D= INSIDE DIAMETER OF PIPE, OR WIDTH OF RCBC
- t₁= DEPTH OF ASPHALT SURFACE COURSE
- t₂= DEPTH FOR ASPHALT BASE COURSE

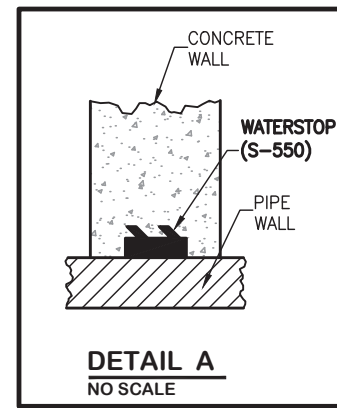
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STANDARD DETAILS TRENCHING AND BEDDING PAGE 1 S-301.1					



TYPICAL CUTOFF WALL LOCATIONS

CUTOFF WALL NOTES:

- 2.1 NOMINAL SPACING IS $\pm 300'$, TYPICALLY AT MIDBLOCK AND EACH SIDE OF CROSS STREET, OR AS SPECIFIED ON PLANS OR AS DIRECTED BY THE CITY.
- 2.2 WHEN GROUNDWATER IS ENCOUNTERED, INSTALL CUTOFF WALL PER DETAIL.



DETAIL A
NO SCALE

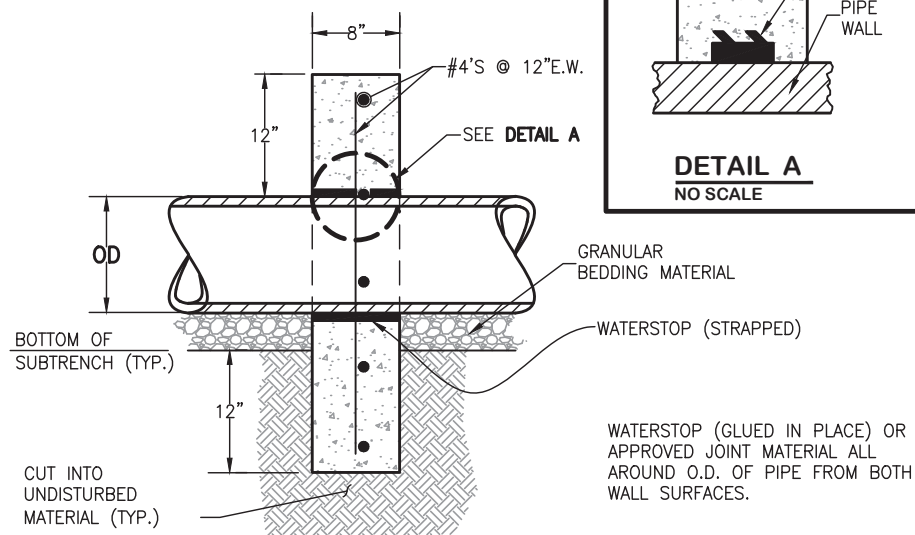


FIG. 3 CONCRETE CUTOFF WALL
NO SCALE

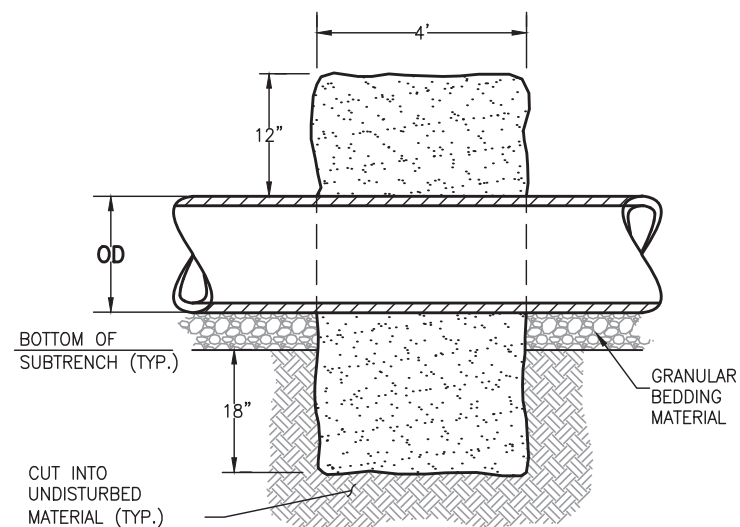


FIG. 4 CLAY CUTOFF WALL
NO SCALE

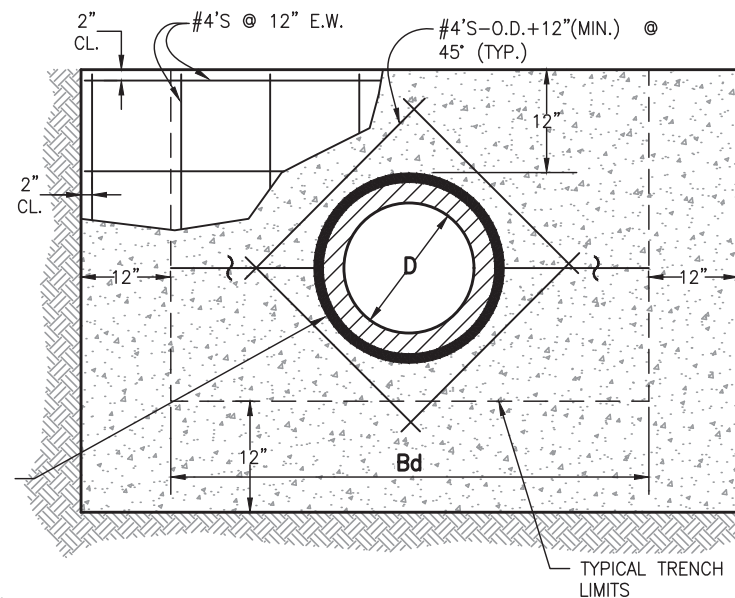


FIG. 5 CONCRETE CRADLE
NO SCALE

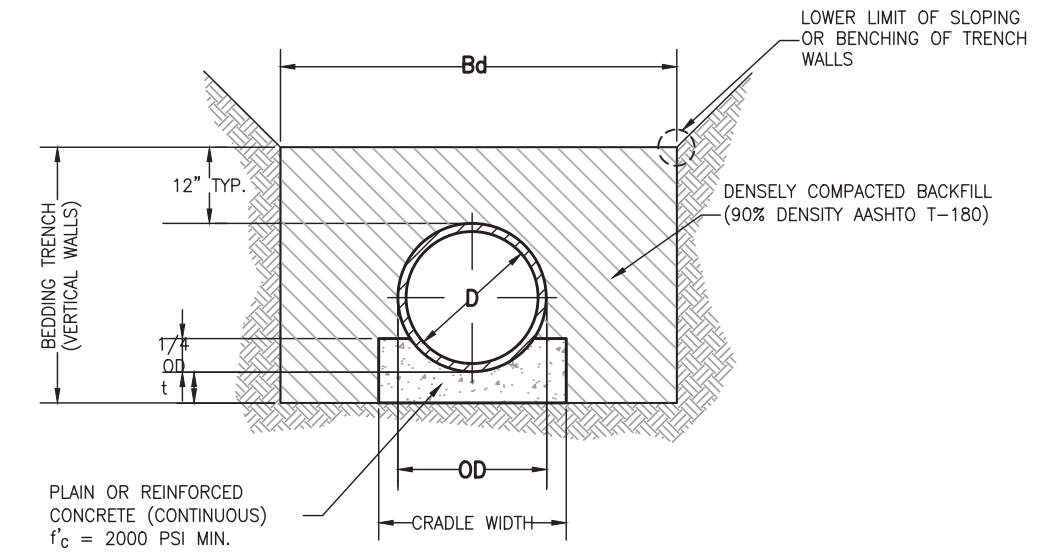


FIG. 6 CONCRETE ARCH
NO SCALE

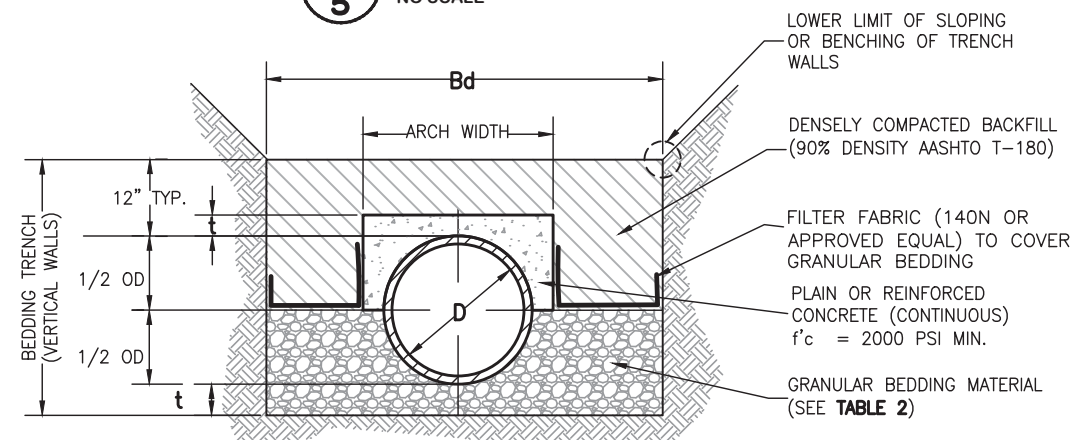


TABLE 2. CONCRETE BEDDING REQUIREMENTS
(CONCRETE CRADLE OR CONCRETE ARCH)

NOMINAL DIAMETER, D	MINIMUM THICKNESS, t	MIN. WIDTH OF CRADLE OR ARCH
18" & SMALLER	4"	OD + 8"
21" TO 24"	6"	OD + 8"
27" TO 33"	8"	OD + 8"
36" TO 42"	10"	1.25 OD
48" & LARGER	1/4" D	1.25 OD

LEGEND

- Bd= TRENCH WIDTH, INCLUDING SHORING (SEE S-301.1)
- D= INSIDE DIAMETER OF PIPE, OR SPAN DIMENSION FOR ARCH OR ELLIPTICAL
- OD= OUTSIDE DIAMETER OF PIPE
- t= CONCRETE BEDDING THICKNESS

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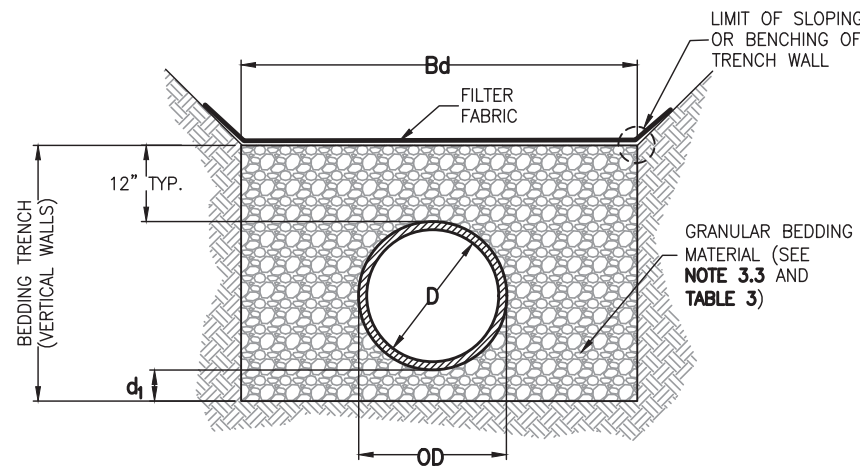


FIG. 7
NO SCALE
IDEAL TRENCH CONDITIONS FOR CONCRETE 15" Ø AND SMALLER, AND ALL FLEXIBLE CONDUITS

GRANULAR BEDDING REQUIREMENTS

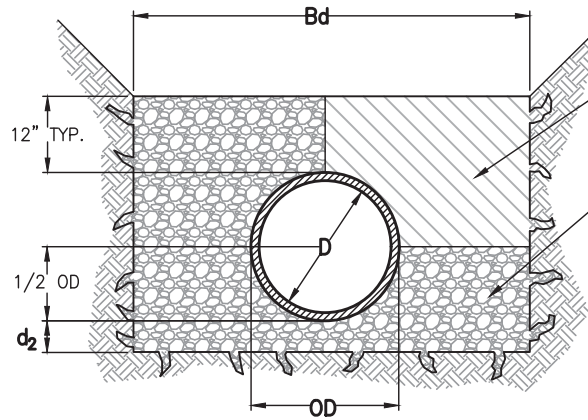


FIG. 9
NO SCALE
ROCK EXCAVATION

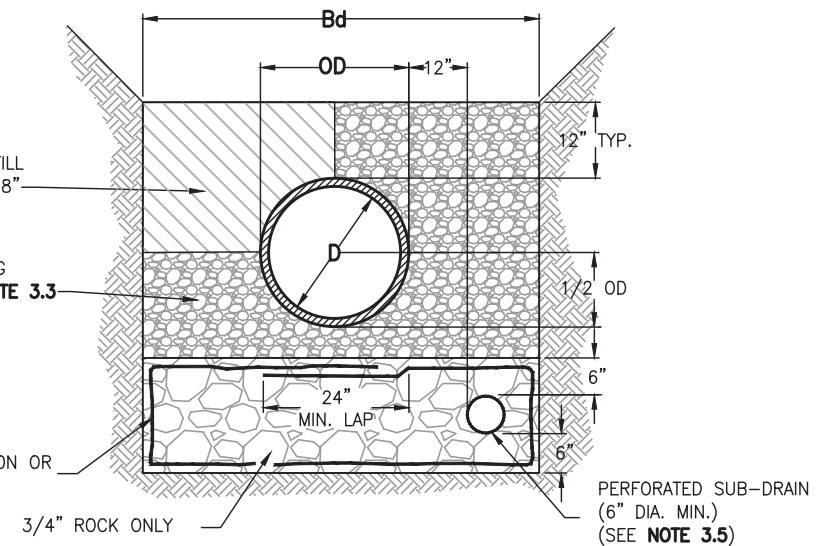


FIG. 11
NO SCALE
TRENCH SUB-DRAIN DETAIL

NOTE: THIS DETAIL MAY BE USED AT THE CONTRACTOR'S CONVENIENCE WHEN GROUNDWATER IS ENCOUNTERED IN THE TRENCH. IT IS INTENDED TO PROVIDE A MEANS OF MAINTAINING DRY CONDITIONS IN THE BEDDING TRENCH DURING CONSTRUCTION AND SHALL NOT BE USED FOR ANY OTHER PURPOSE.

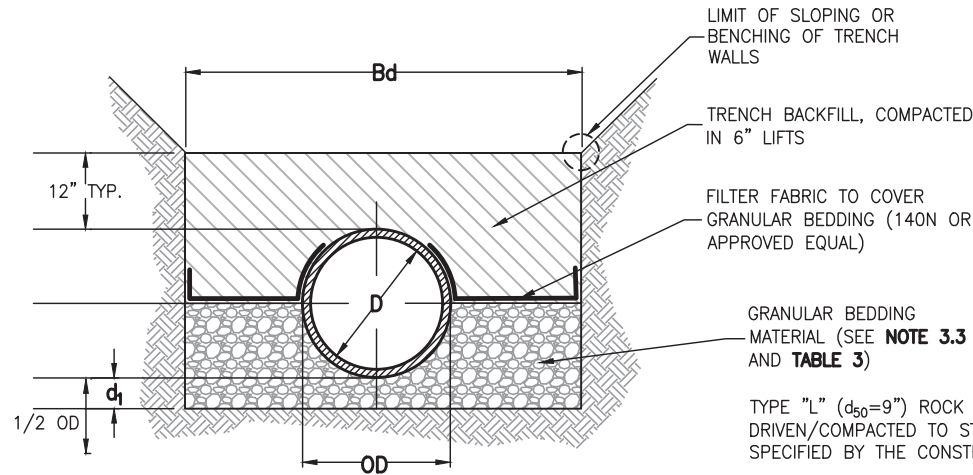


FIG. 8
NO SCALE
IDEAL TRENCH CONDITIONS FOR CONCRETE LARGER THAN 15" Ø

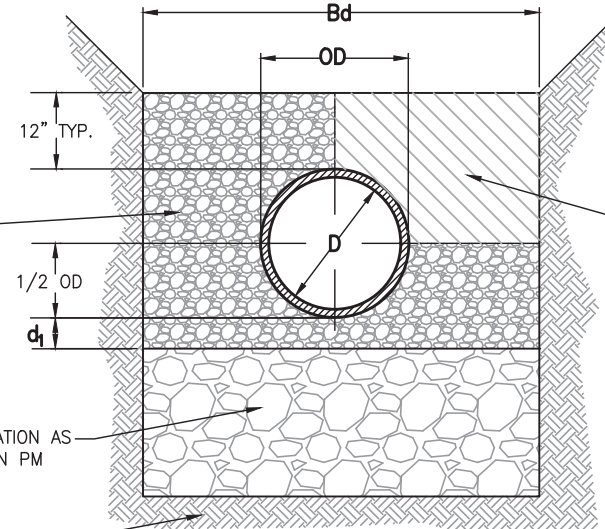


FIG. 10
NO SCALE
STABILIZED TRENCH

GRANULAR BEDDING NOTES:

- 3.1 THESE DETAILS ARE TYPICAL FOR NORMAL CONDITIONS. FOR INSTALLATIONS OTHER THAN THESE (SUCH AS EMBANKMENT OR TUNNEL INSTALLATIONS, ETC.) EXCAVATION, BEDDING AND BACKFILL REQUIREMENTS SHALL BE DETAILED ON THE CONSTRUCTION DRAWINGS AND SHALL BE DESIGNED IN ACCORDANCE WITH THE REFERENCES NOTED (W.P.C.F. MANUAL PRACTICE NO. 9, A.S.C.E. MANUAL NO. 37 LATEST REVISION) AND APPROVED BY THE DESIGN ENGINEER. FOR UNUSUAL OR UNSTABLE SOIL CONDITIONS, TRENCH AND BEDDING DETAILS SHALL BE A SPECIAL DESIGN.
- 3.2 ULTIMATE BACKFILL LOADS AND STRUCTURAL DESIGN OF PIPE OR CONDUIT SHALL BE BASED UPON $B_d >$ TRANSITION WIDTH AS SET FORTH IN THE AMERICAN CONCRETE PIPE ASSOCIATION DESIGN MANUAL.
- 3.3 BEDDING SHALL BE MECHANICALLY TAMPED IN 6" LIFTS AND SHALL CONFORM TO ASTM C-33. GRADATION SIZE #67 (PER CCD WCPM STANDARD CONSTRUCTION SPECIFICATIONS, SECTION 4.00 & 5.00 AND TABLE 3 ABOVE.)
- 3.4 BELL HOLES SHALL BE EXCAVATED AT ALL BELL AND SPIGOT JOINTS.
- 3.5 SUBDRAIN PIPE TO BE AN APPROVED PERFORATED PIPE CONFORMING TO APPLICABLE REQUIREMENTS OF THE SPECIFICATIONS.
- 3.6 BEDDING TRENCH BACKFILL TO BE COMPACTED TO 90% DENSITY, AASHTO T-180.
- 3.7 FILTER FABRIC TO COVER GRANULAR BEDDING MATERIAL AS SHOWN IN IDEAL TRENCH CONDITIONS DETAIL IN ALL CASES.
- 3.8 DESIGN ENGINEER TO SPECIFY WHEN FILTER FABRIC IS NECESSARY BETWEEN EXISTING SUBGRADE AND GRANULAR BACKFILL. REFER TO CURRENT MGPEC PAVEMENT DESIGN STANDARDS 2019 (SECTION 4.2.4B) ON PIPING AND PERMEABILITY CRITERIA. (USE GRANULAR BACKFILL IN THIS DETAIL AS THE MSB IN MGPEC. REFER TO MGPEC.ORG.)
- 3.9 FOR 60" AND LARGER, USE SPECIAL BEDDING AND FILTER FABRIC MAY BE OMITTED.

TABLE 3. CLASS 67 GRADATION
(ASTM C-33)

SIEVE SIZE	% BY WEIGHT
3/4"	90 - 100
3/8"	20 - 55
NO. 4	0 - 10
NO. 8	0 - 5

NOTE: SEE SECTION 4.00 OF THE CCD WCPM STANDARD CONSTRUCTION SPECIFICATIONS.

TABLE 4. MIN. DEPTH OF BEDDING MATERIAL BELOW BOTTOM OF PIPE

PIPE SIZE - D*	d	d ₁	d ₂
18" & SMALLER	4"	6"	12"
21" TO 36"	6"	6"	12"
42" TO 60"	8"	6"	12"
66" TO 96"	10"	9"	12"
104" & LARGER	12"	12"	12"

* FOR ARCH OR ELLIPTICAL PIPE. D = SPAN DIMENSION.

LEGEND

- B_d= TRENCH WIDTH, INCLUDING SHORING (SEE S-301.1)
- D= INSIDE DIAMETER OF PIPE, OR SPAN DIMENSION FOR ARCH OR ELLIPTICAL
- d, d₁, d₂= DEPTH OF BEDDING MATERIAL BELOW BOTTOM OF PIPE
- OD= OUTSIDE DIAMETER OF PIPE

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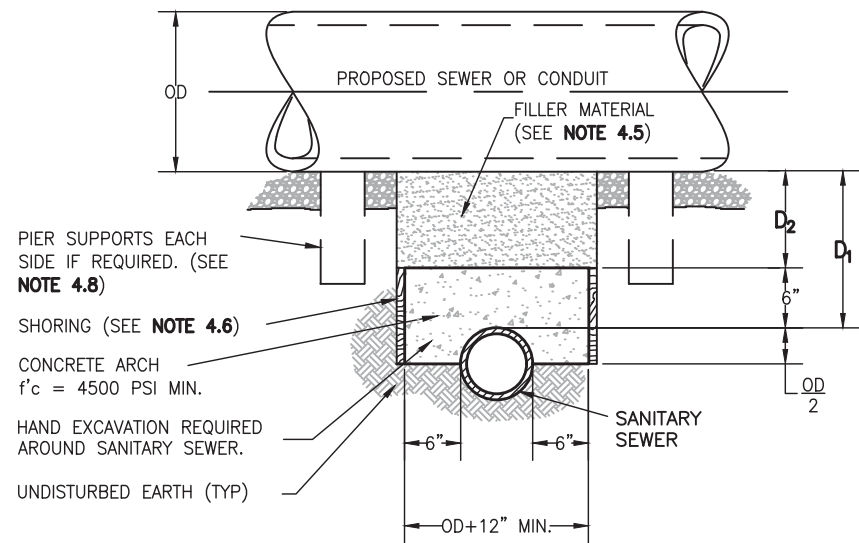
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STANDARD DETAILS
TRENCHING AND BEDDING
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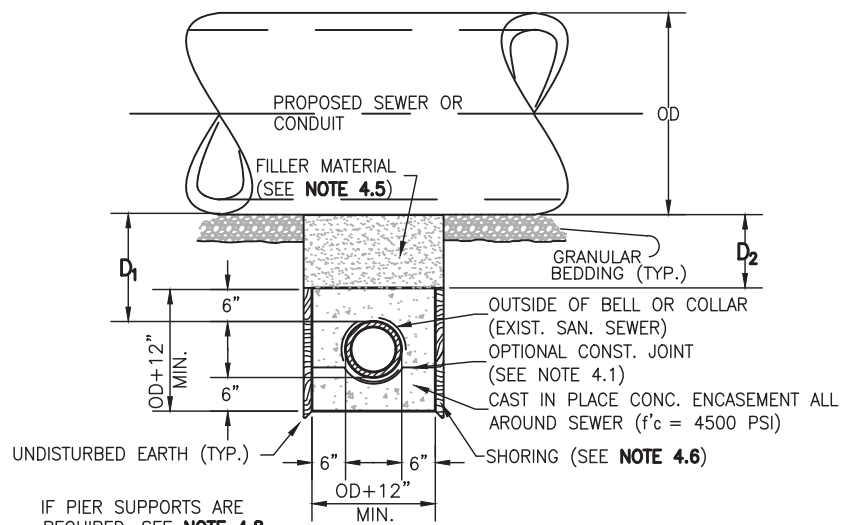
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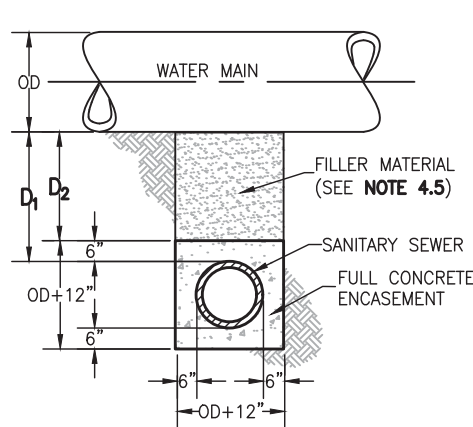


**TYPE I
CONCRETE ARCH**
NO SCALE

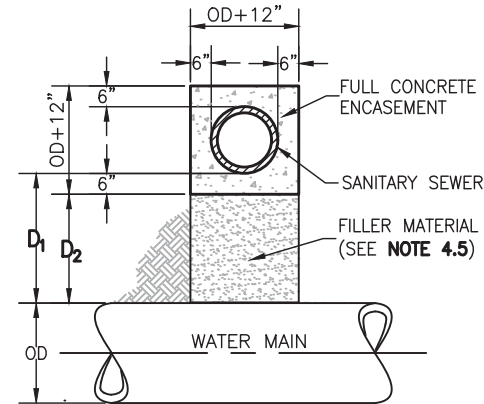


IF PIER SUPPORTS ARE REQUIRED, SEE NOTE 4.8 (NOT SHOWN)

**TYPE III
FULL ENCASEMENT**
NO SCALE



**TYPE IIA
SANITARY SEWER CROSSING UNDER WATER MAIN**
IF $D_1 > 24"$, ENCASEMENT NOT REQUIRED



**TYPE IIB
SANITARY SEWER CROSSING OVER WATER MAIN**
FULL ENCASEMENT REQUIRED REGARDLESS OF DIMENSION "D1"

**TYPE II
WATER MAIN CROSSING**
NO SCALE

GENERAL NOTES FOR TYPE I, II & III ENCASEMENT:

- 4.1 CONCRETE TO BE CAST AGAINST UNDISTURBED SOIL OR SHORING. IF OPTIONAL CONSTRUCTION JOINT IS USED AND BOTTOM HALF OF ENCASEMENT IS POURED SEPARATELY, A ONE INCH LAYER OF SAND OR MORTAR SHALL BE PLACED BETWEEN BOTTOM OF SANITARY SEWER AND TOP OF CONCRETE.
- 4.2 LENGTH OF ENCASEMENT FOR :
 - (A) TYPE I & III ENCASEMENT SHALL EXTEND FULL TRENCH WIDTH EXCAVATED FOR PROPOSED SEWER OR CONDUIT.
 - (B) TYPE II ENCASEMENT SHALL EXTEND AT LEAST 10 FEET EACH SIDE OF WATER MAIN.
- 4.3 UNLESS OTHERWISE NOTED ON PLAN/PROFILE DRAWINGS, TYPE I, II, & III ENCASEMENTS NEED NOT BE REINFORCED. REINFORCEMENT, IF REQUIRED, TO BE SPECIFIED AND DETAILED SEPARATELY ON PLAN & PROFILE DRAWINGS.
- 4.4 TYPE I, II OR III ENCASEMENT REQUIRED UNDER FOLLOWING CONDITIONS:
 - (A) TYPE I OR TYPE III IF $D_1 \leq 18"$ ($D_2 \leq 12"$) EXCEPT FOR SANITARY SEWERS CROSSING OVER OR UNDER WATER MAINS.
 - (B) TYPE IIA REQUIRED FOR SANITARY SEWERS CROSSING UNDER WATER MAINS AND $D_1 \leq 24"$ ($D_2 \leq 18"$).
 - (C) TYPE IIB REQUIRED FOR SANITARY SEWERS CROSSING OVER TOP OF WATER MAINS, REGARDLESS OF DIMENSION "D1".
 - (D) EXCEPT FOR UNUSUAL CIRCUMSTANCES, WATER MAIN CROSSINGS, OR WHERE UNSTABLE SOIL CONDITIONS ARE ENCOUNTERED, TYPE I ENCASEMENT WILL NORMALLY BE SATISFACTORY.
 - (E) IF THE SANITARY SEWER IS REPLACED OR CONSTRUCTED OF CAST IRON PIPE (AWWA C-106 OR C-108) OR DUCTILE IRON PIPE (AWWA C-150 OR C-151), CONCRETE ENCASEMENT MAY NOT BE REQUIRED.
- 4.5 FILLER MATERIAL BETWEEN CONDUITS TO BE:
 - (A) APPROVED COMPRESSIBLE MATERIAL SUCH AS STYROFOAM, ETC., IF $D_2 \leq 6"$.
 - (B) COMPACTED GRANULAR BEDDING IF $D_2 > 6"$. (IF $D_2 > 6"$ FOR TYPE IIB ENCASEMENT POUR CONCRETE ON UNDISTURBED SOIL).
 - (C) OR DICTATED BY UTILITY OWNER.
- 4.6 SHORING OR SHEETING, IF USED, TO BE CUT OFF AT TOP OF ENCASEMENT.
- 4.7 THESE ENCASEMENT DETAILS MAY ALSO BE APPLICABLE FOR CONDUITS OTHER THAN STORM OR SANITARY SEWER INSTALLATIONS.
- 4.8 IN CERTAIN SITUATIONS WHERE THE EXISTING CONDUIT DIAMETER IS EXTREMELY LARGE, PIER SUPPORTS ON EACH SIDE OF SANITARY SEWER MAY ALSO BE REQUIRED. IF REQUIRED, SUPPORTS TO BE SPECIFIED AND DETAILED SEPARATELY ON PLAN AND PROFILE DRAWINGS. NO PIPE JOINTS OVER TOP OF WATER MAIN.
- 4.9 INTERNATIONAL PLUMBING CODE APPROVED MATERIALS ALLOWED.

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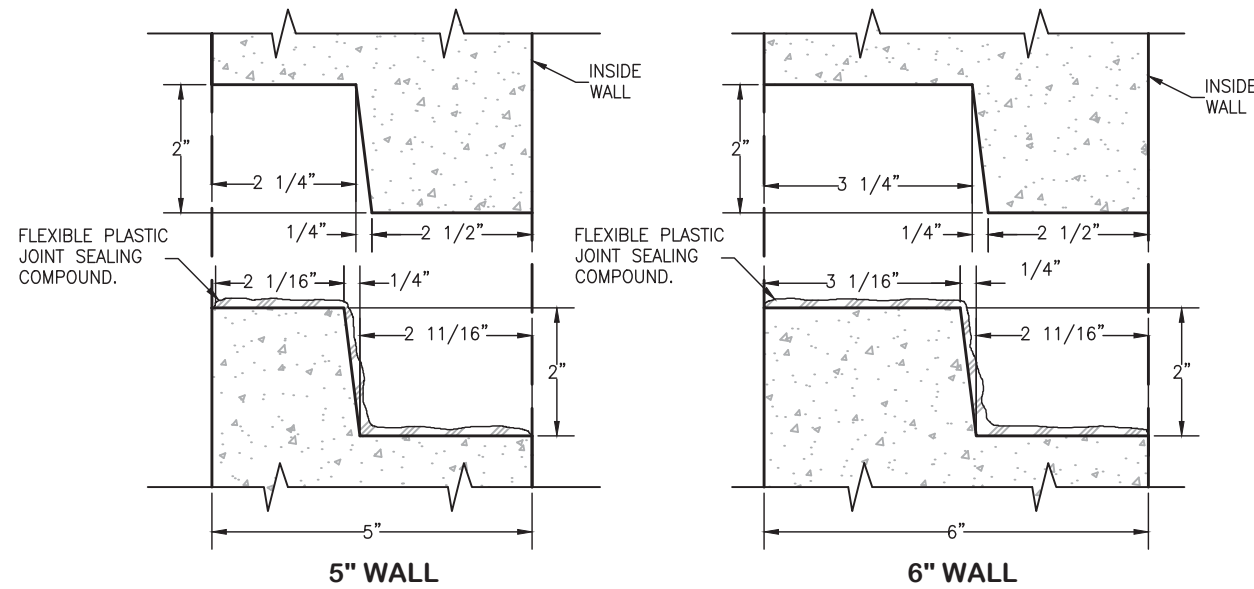


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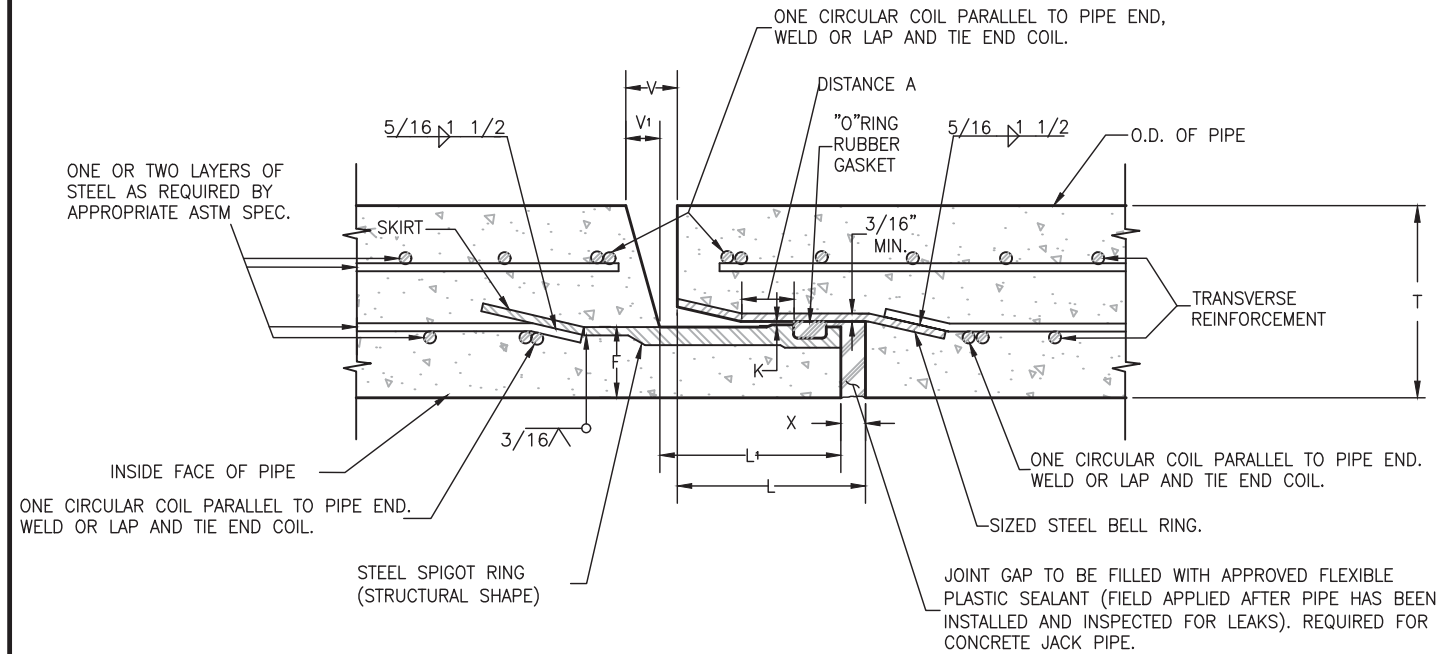
STANDARD DETAILS
ENCASEMENT OF SANITARY SEWERS
S-350

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APPROVED BY:	---
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SHEET NO.:	4

LEGEND
OD= OUTSIDE DIAMETER OF PIPE
D₁= DISTANCE OD TO OD
D₂= DEPTH OF FILLER MATERIAL



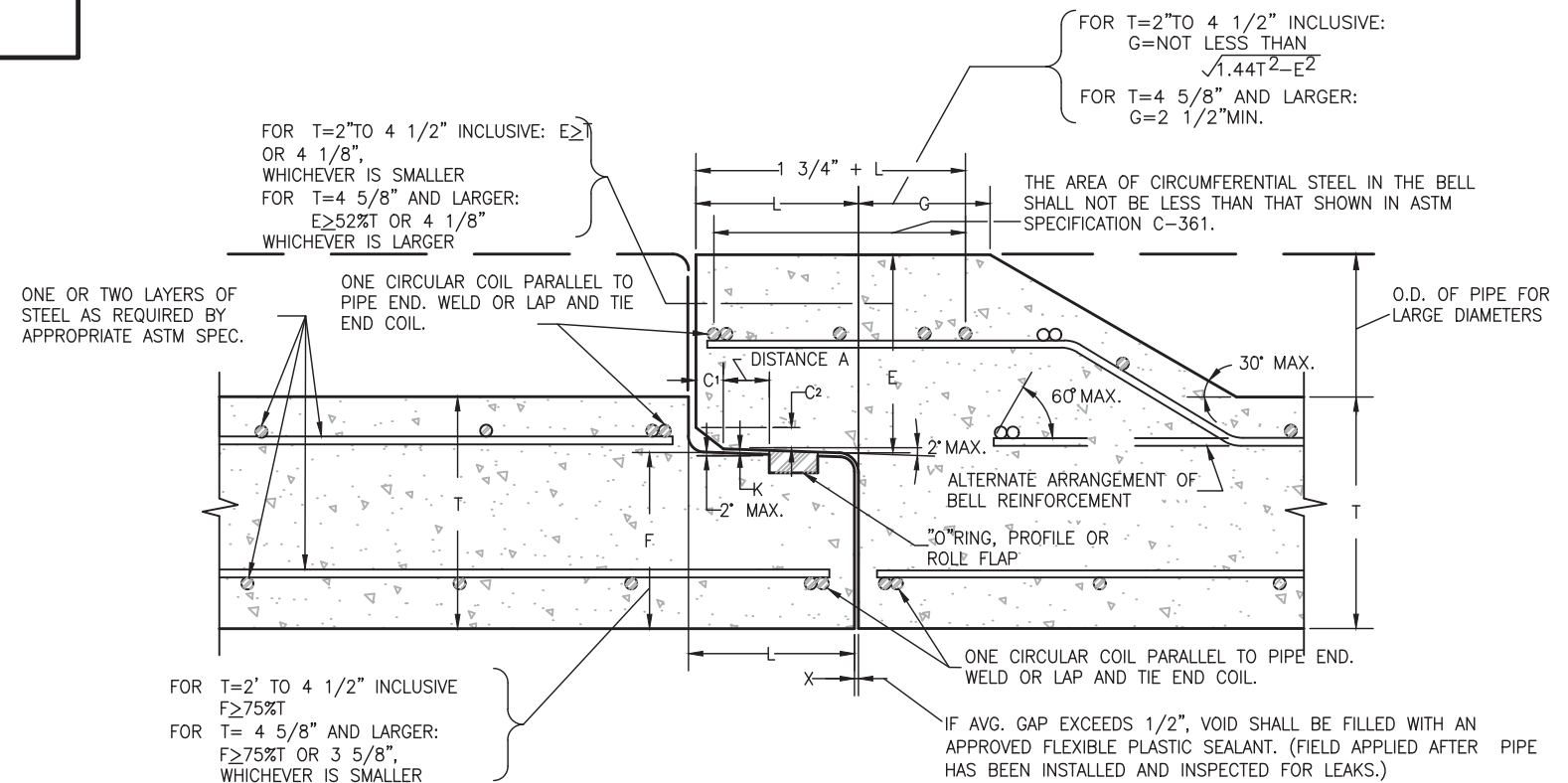
SHIPLAP JOINTS FOR REINFORCED CONCRETE MANHOLE SECTIONS
NO SCALE



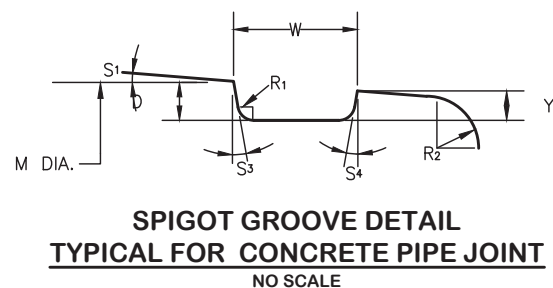
STEEL END RING DETAIL (FOR JACKED PIPE)
NO SCALE

PIPE JOINT NOTES:

- 5.1 THE CONTRACTOR SHALL SUBMIT ALL TOLERANCES AND DIMENSIONS, REQUIRED BY THE SPECIFIC PIPE JOINT DETAILS SHOWN, TO THE ENGINEER PRIOR TO FABRICATION.
- 5.2 ALL DIMENSIONS SHALL BE GIVEN IN INCHES, UNLESS OTHERWISE NOTED, AND ARE FOR BELL AND SPIGOT IN CONCENTRIC POSITION. DEFLECTED PIPE JOINT TOLERANCES & DIMENSIONS SHALL ALSO BE FURNISHED.
- 5.3 JOINT CLEARANCE DIMENSION K IS AT CLOSEST POINT WITHIN DISTANCE A.
- 5.4 RUBBER "O" RING GASKET SHALL BE IN CONFORMANCE W/ASTM C-443 OR C-361.
- 5.5 APPLICABLE CONCRETE PIPE JOINT SPECIFICATIONS:
 - A. ASTM C-76
 - B. ASTM C-361
- 5.6 STEEL REINFORCEMENT SHALL BE IN ACCORDANCE WITH THE APPROPRIATE ASTM SPECIFICATION FOR THE PIPE SIZE AND STRENGTH CLASS AS SPECIFIED ON PLAN/PROFILE DRAWINGS.
- 5.7 NO CONNECTION TO GO THROUGH JOINT WITHOUT PRIOR CITY APPROVAL.



CONCRETE PIPE O-RING JOINT
NO SCALE



SPIGOT GROOVE DETAIL TYPICAL FOR CONCRETE PIPE JOINT
NO SCALE

LEGEND
K= JOINT CLEARANCE DISTANCE
T= WALL THICKNESS OF PIPE

PLOT DATE: May 1, 2020

S:\STAFF_FOLDERS\CRMA\WASTEWATER STANDARD DETAILS\REVISED 2018\S401.DWG

NO.	DESCRIPTION OF REVISIONS	DATE	BY



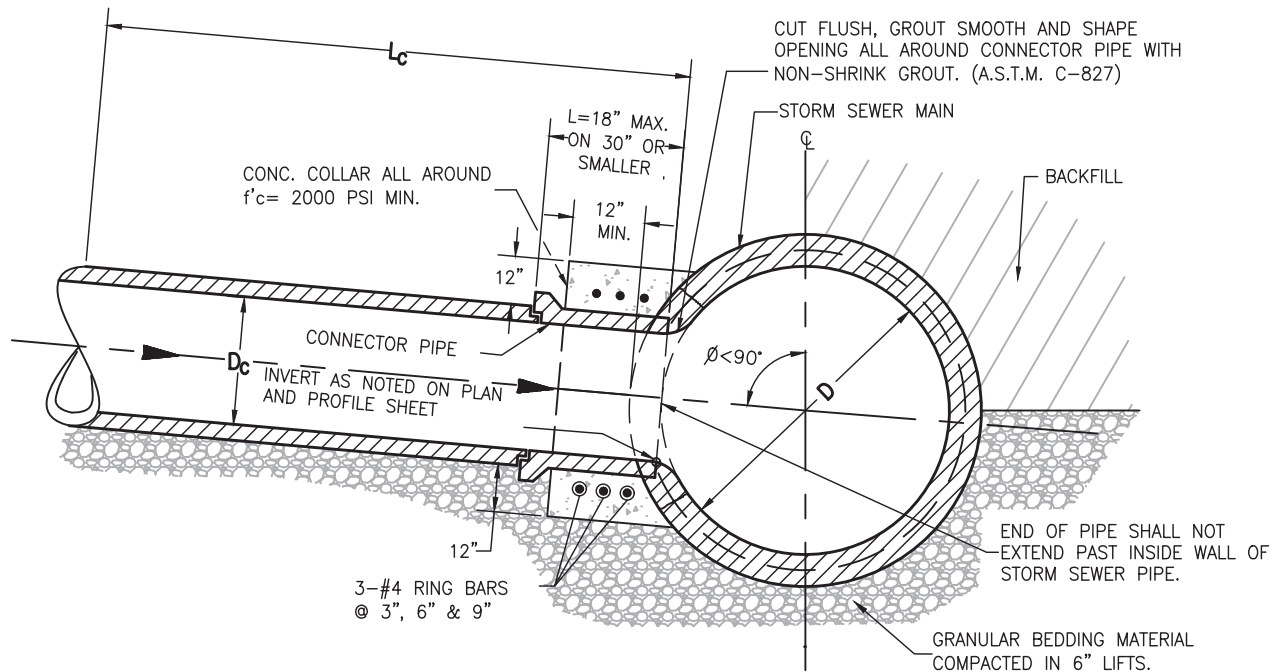
CITY AND COUNTY OF DENVER
2000 W. 3RD AVE. DENVER, CO 80223
www.denvergov.org

STANDARD DETAILS
SHIPLAP JOINTS-PIPE JOINTS
S-401

DRAWN BY:	KRC
DESIGNED BY:	---
APPROVED BY:	---
DRAWING NAME:	S401.dwg
DATE:	JUNE 2020
SHEET NO.:	5

PLOT DATE: May 1, 2020

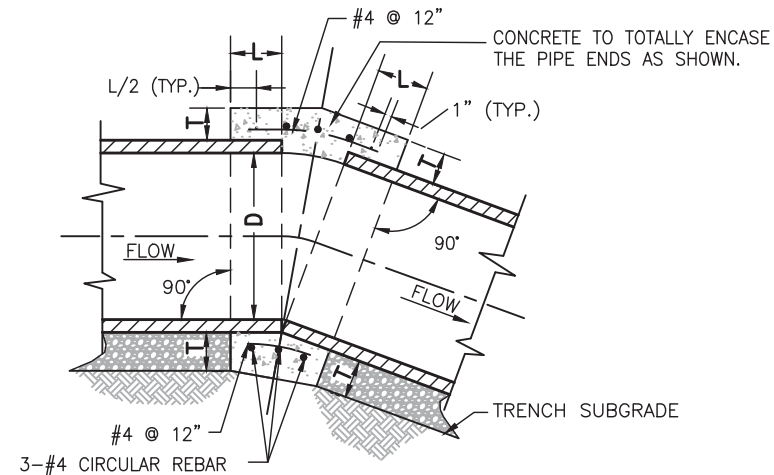
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INLET CONNECTION NOTES:

- 6.1 THIS TYPE OF CONNECTION SHALL ONLY BE USED IF THE FOLLOWING CONDITIONS ARE MET:
 - (A) $D_c \leq 3/4 D$ & $L_c \leq 35$ FT.
 - (B) THE POINT OF CONNECTION TO THE SEWER MAIN IS NOT MORE THAN 75 FEET FROM THE NEAREST MANHOLE ON THE SEWER MAIN.
 - (C) INLETS ARE NOT CONNECTED IN SERIES.
 - (D) ONLY ONE INLET CONNECTION ALLOWED PER JOINT OF SEWER MAIN PIPE.
- 6.2 FOR CONDITIONS OTHER THAN THAT SPECIFIED IN NOTE 6.1, A MANHOLE ON THE SEWER MAIN WILL BE REQUIRED.
- 6.3 THIS DETAIL APPLIES TO STORM SEWER CONNECTIONS ONLY. SANITARY SEWER TAPS SHALL BE MADE ONLY WITH APPROVED MECHANICAL TAPPING EQUIPMENT AND APPROVED TAPPING SADDLES/FITTINGS.

INLET CONNECTION INTO STORM SEWER MAIN
(STORM SEWER INSTALLATION ONLY)
NO SCALE



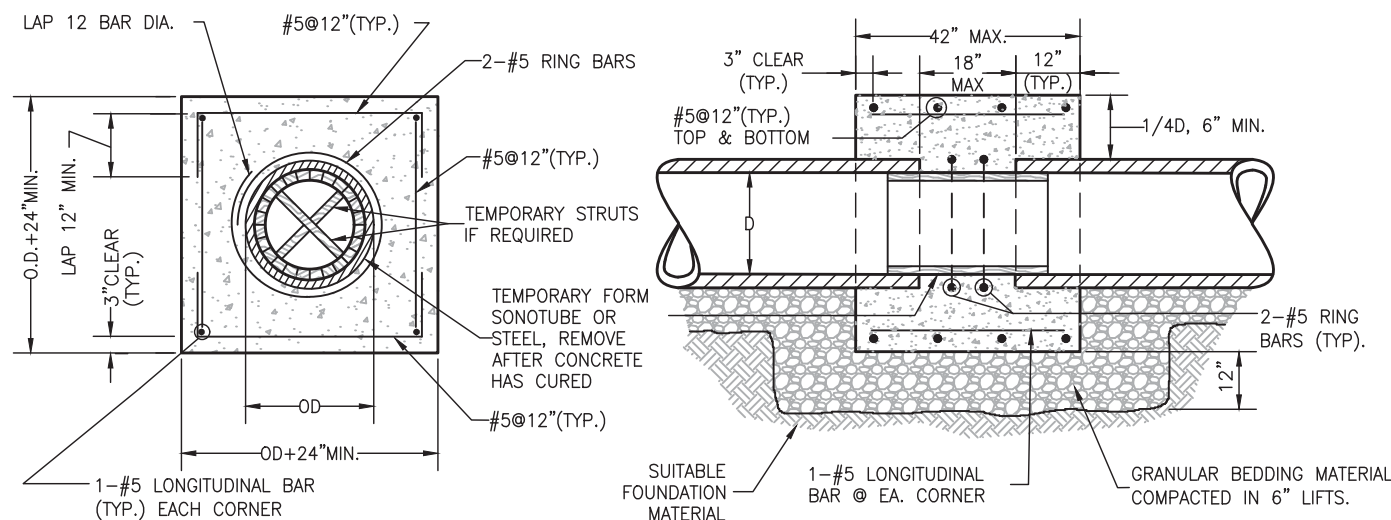
VERTICAL SECTION

D	L	T
15"	18"	12"
18"	18"	12"
21"	18"	12"

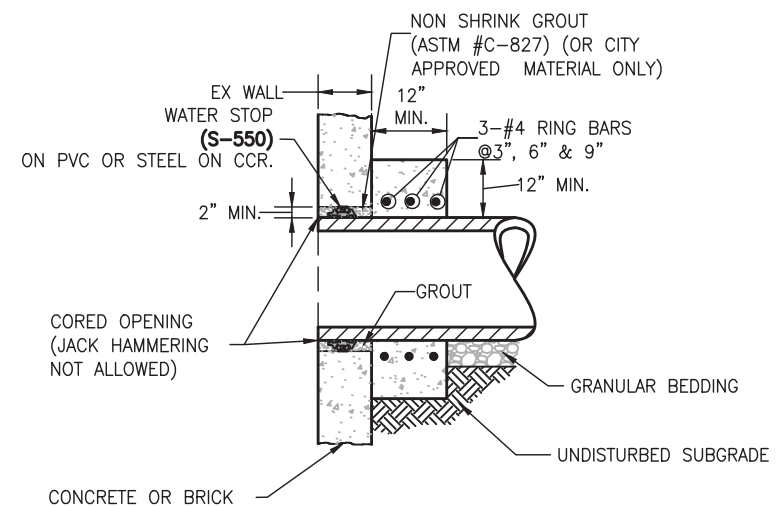
PIPE COLLAR NOTES:

- 6.4 FOR STORM LINE LATERALS ONLY. NOT TO BE USED ON SANITARY OR MAINLINE STORM SEWERS.
- 6.5 A CONCRETE COLLAR IS REQUIRED WHERE THE CHANGE IN GRADE EXCEEDS 0.10 FOOT PER FOOT, AND WHERE GAP LIMITS EXCEED THE PIPE MANUFACTURER'S RECOMMENDATIONS.
- 6.6 IF THE GAP EXCEEDS 6 INCHES, A MANHOLE STRUCTURE IS REQUIRED.
- 6.7 REINFORCING SHALL BE USED WHERE THE GAP IS 2 1/2" OR LARGER. THREE CIRCULAR TIES SHALL BE USED PER THE VERTICAL SECTION ABOVE.
- 6.8 CONCRETE COLLAR SHALL NOT BE USED FOR A SIZE CHANGE ON THE MAIN LINE.
- 6.9 FOR PIPE SIZE NOT LISTED USE NEXT SIZE LARGER.
- 6.10 WHERE REINFORCING IS REQUIRED, THE DIAMETER OF THE CIRCULAR TIES SHALL BE $D+(2X \text{ WALL THICKNESS})+T$.
- 6.11 AN INTERIOR FORM OF UNSEALED SONO-TUBE OR EQUAL SHALL BE USED TO PROVIDE A SMOOTH INTERIOR JOINT. THE PAPER FORM MAY BE LEFT IN PLACE.
- 6.12 PIPES 24" AND LARGER TO BE DESIGNED BY ENGINEER AND APPROVED BY CITY.

STORM LATERAL PIPE COLLAR DETAIL (21" DIA. OR LESS)
(TO BE USED ONLY WHERE NECESSARY AND AS AUTHORIZED BY THE CITY)
NO SCALE



CONCRETE COLLAR DETAIL
NO SCALE



CONNECTOR PIPE INTO WALL OF EXISTING OR PRECAST STRUCTURE
NO SCALE

LEGEND

- D= INSIDE DIAMETER OF PIPE
- Dc= INSIDE DIAMETER OF CONNECTOR PIPE
- Lc= LENGTH OF CONNECTOR PIPE
- L= LENGTH OF CLOSURE OVERLAPPING PIPE
- OD= OUTSIDE DIAMETER OF PIPE
- T= THICKNESS OF CONCRETE

NO.	DESCRIPTION OF REVISIONS	DATE	BY



CITY AND COUNTY OF DENVER
2000 W. 3RD AVE. DENVER, CO 80223
www.denvergov.org

STANDARD DETAILS
INLET CONNECTIONS AND PIPELINE COLLARS
S-450

DRAWN BY:	KRC
DESIGNED BY:	---
APPROVED BY:	---
DRAWING NAME:	S450.dwg
DATE:	JUNE 2020
SHEET NO.:	6

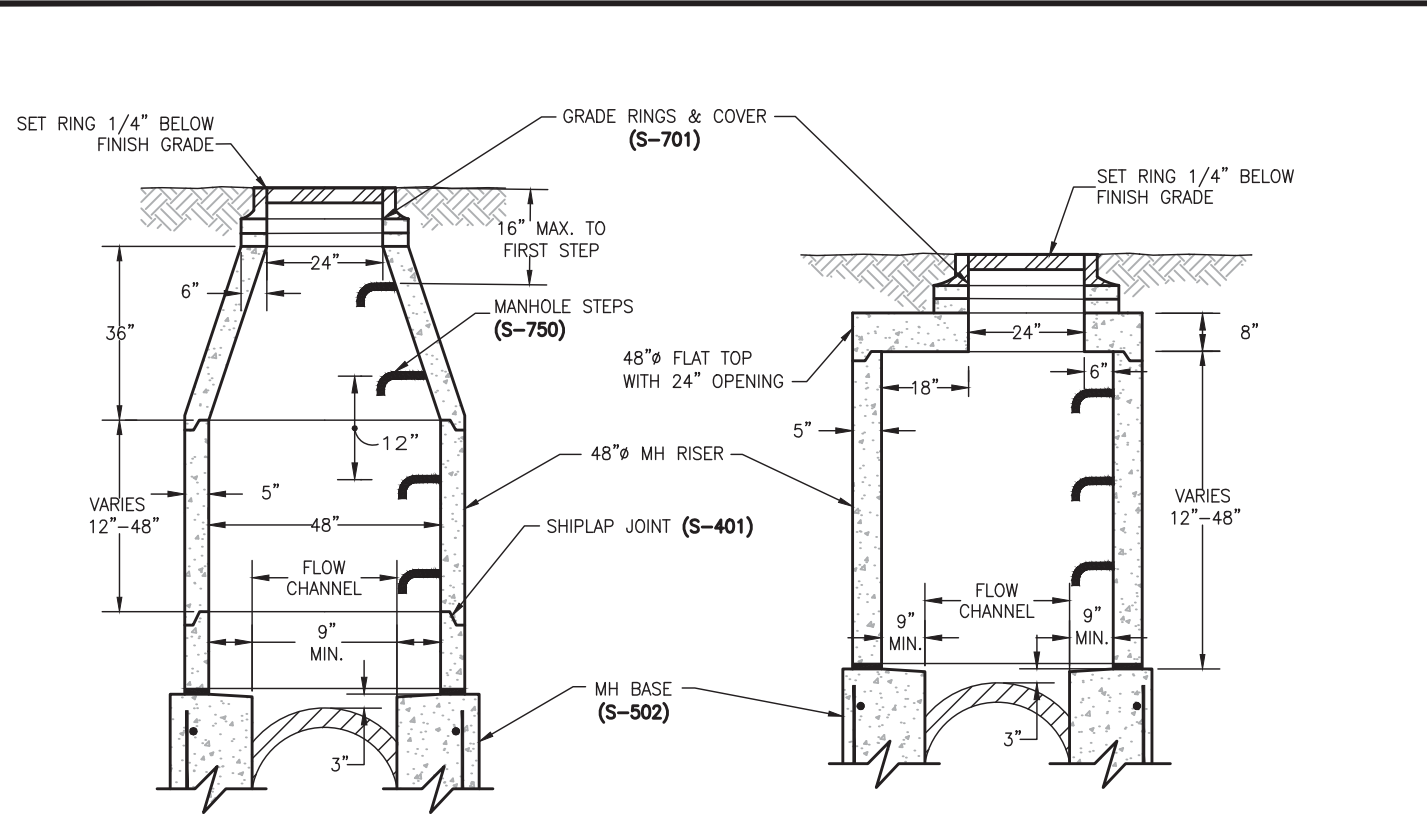


FIG. 1A 4' I.D. MH W/ CONCENTRIC CONE
NO SCALE

FIG. 1B 4' I.D. MH W/ FLAT TOP
(FOR SHALLOW COVER LESS THAN 4' TO BENCH)
NO SCALE

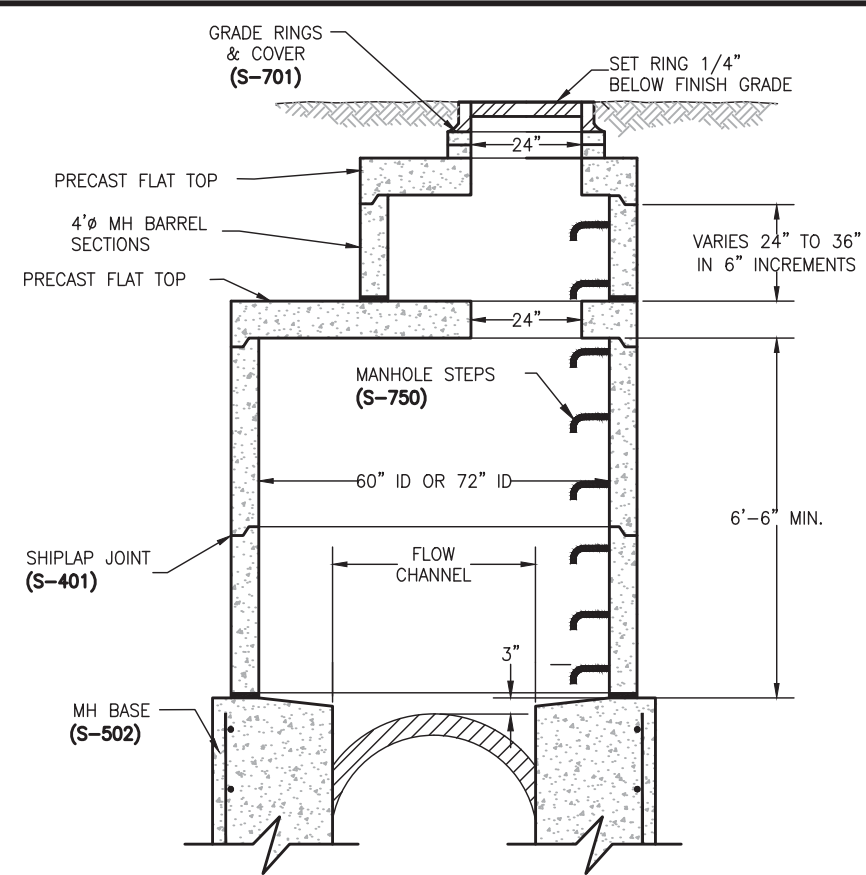


FIG. 3 FLAT TOP WITH ECCENTRIC OPENING
NO SCALE

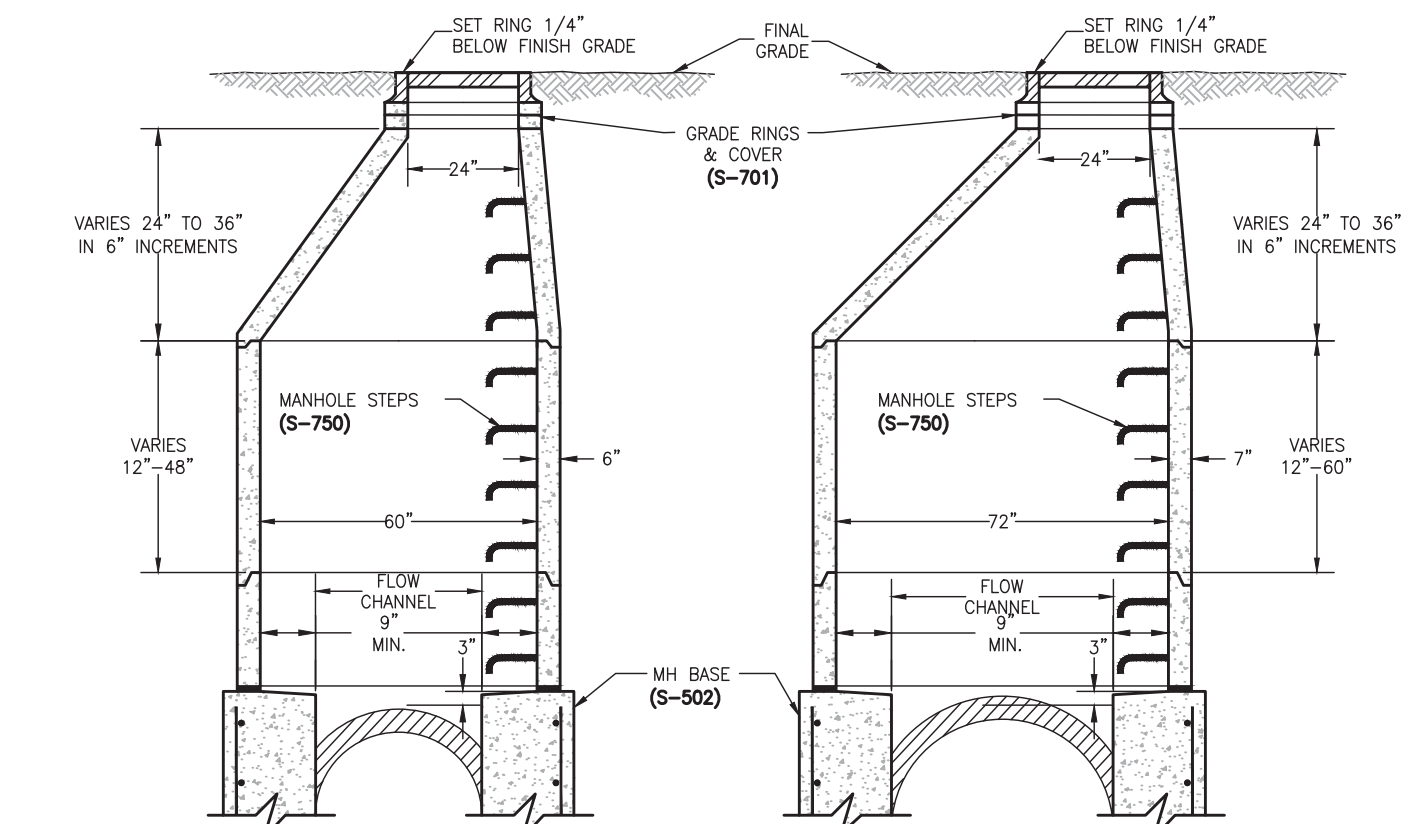


FIG. 2A 5' I.D. MH WITH ECCENTRIC CONE
NO SCALE

FIG. 2B 6' I.D. MH WITH ECCENTRIC CONE
NO SCALE

MANHOLE NOTES:

- 7.1 FLAT TOP SECTIONS MAY BE USED IN LIEU OF CONCENTRIC MANHOLES WHEN SPECIFICALLY APPROVED BY THE PROJECT ENGINEER.
- 7.2 FOR MANHOLE DEPTHS LESS THAN 4' FROM RIM TO TOP OF BENCH, MANHOLE RISERS WITH PRECAST FLAT TOP SECTIONS ARE REQUIRED.
- 7.3 ALL PRECAST RISER SECTIONS, CONES, GRADE RINGS, ETC. SHALL CONFORM TO THE LATEST REVISION OF ASTM C-478, STANDARD SPECIFICATION FOR CIRCULAR PRECAST REINFORCED CONCRETE MANHOLE SECTIONS.
- 7.4 FLAT TOPS SHALL BE CAPABLE OF WITHSTANDING H-20 LIVE LOADS.
- 7.5 MANHOLE RISERS, CONES, FLAT TOP SECTIONS AND RINGS SHALL INDICATE DATE, MANUFACTURER, SIZE AND ASTM C-478.
- 7.6 FOR DEPTHS GREATER THAN 20' (RIM TO INVERT) SHOP DRAWINGS, CALCULATIONS OF WALLS, TOP AND BOTTOM SLABS SHALL BE SUBMITTED.
- 7.7 AN APPROVED FLEXIBLE PLASTIC SEALANT IS REQUIRED IN SHIPLAP JOINTS AND IN JOINTS BETWEEN FLAT TOP SECTIONS, CONE SECTIONS, ETC.
- 7.8 DESIGN ENGINEER OR PROJECT ENGINEER MAY INCREASE MH SIZE FOR SPECIAL DESIGN CONSIDERATIONS.
- 7.9 MANHOLE STEPS SHALL NOT BE INSTALLED OVER THE FLOW CHANNEL.
- 7.10 6' DIA MH'S ALLOWED ONLY WITH SPECIFIC APPROVAL OF THE ENGINEER.
- 7.11 48" DIA. & LARGER PIPES SHALL USE TYPE B (S-503) OR TYPE P (S-504).

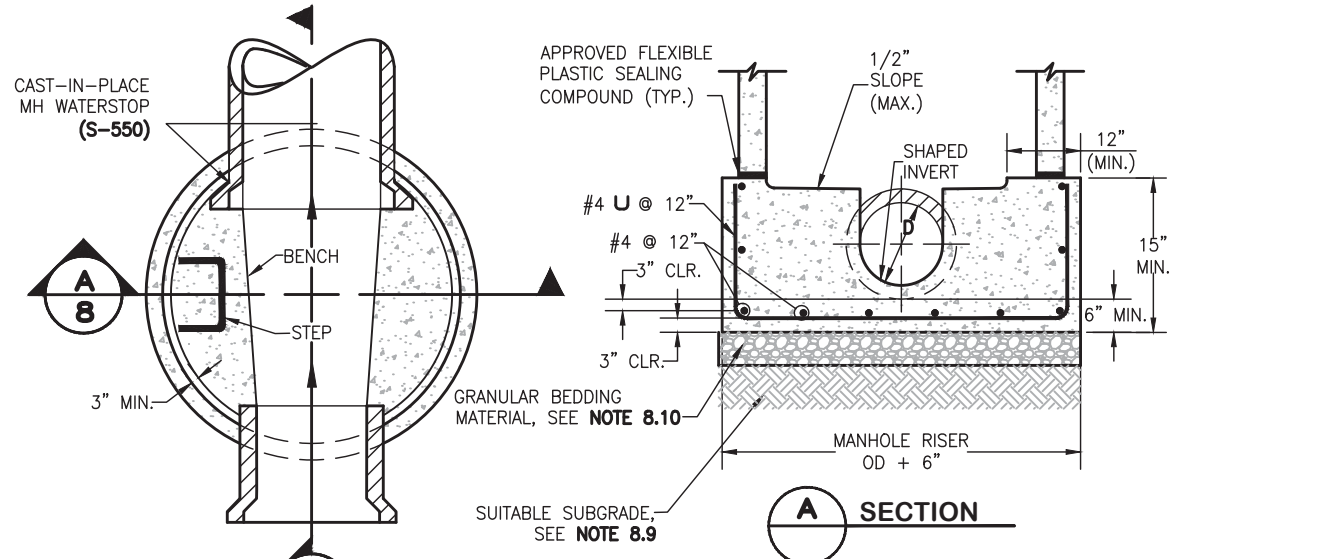
TABLE 6. MIN. MH RISER DIAMETER & WALL THICKNESS		
PIPE DIAMETER	MH DIAMETER, ID	MH WALL THICKNESS, T
30" OR LESS	4'	5"
33"-36"	5'	6"
42"	6'	7"

NOTE: MH RISER DIAMETER SPECIFIED IN TABLE 7 IS FOR SITUATIONS WHERE ONE PIPE ENTERS AND ONE PIPE EXITS AT 180°. SPECIAL CONSIDERATION SHALL BE TAKEN FOR SITUATIONS OTHER THAN THIS. DESIGN ENGINEER SHALL SPECIFY DIAMETER FOR ALL STRUCTURES ON PLANS.

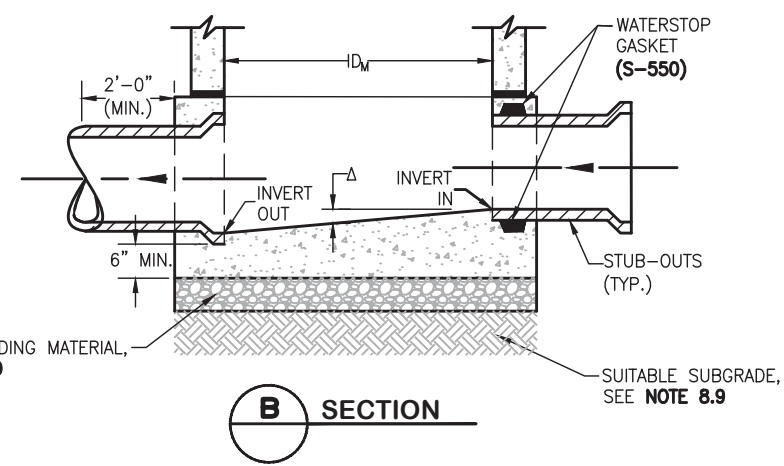
LEGEND
ID= INSIDE DIAMETER OF MANHOLE
OD= OUTSIDE DIAMETER OF MANHOLE
T= MANHOLE WALL THICKNESS

S:\STAFF_FOLDERS\CRMA\WASTEWATER STANDARD DETAILS\REVISED 2018\S501.DWG PLOT DATE: May 1, 2020

BY									
DATE									
DESCRIPTION OF REVISIONS									
NO.									
CITY AND COUNTY OF DENVER 2000 W. 3RD AVE. DENVER, CO 80223 www.denvergov.org									
STANDARD DETAILS PRECAST MANHOLE RISERS AND TOP SECTIONS S-501.1									
DRAWN BY: KRC DESIGNED BY: --- APPROVED BY: --- DRAWING NAME: S501.dwg DATE: JUNE 2020 SHEET NO: 7									



SEE S-501.1 FOR RISER & TOP SECTIONS

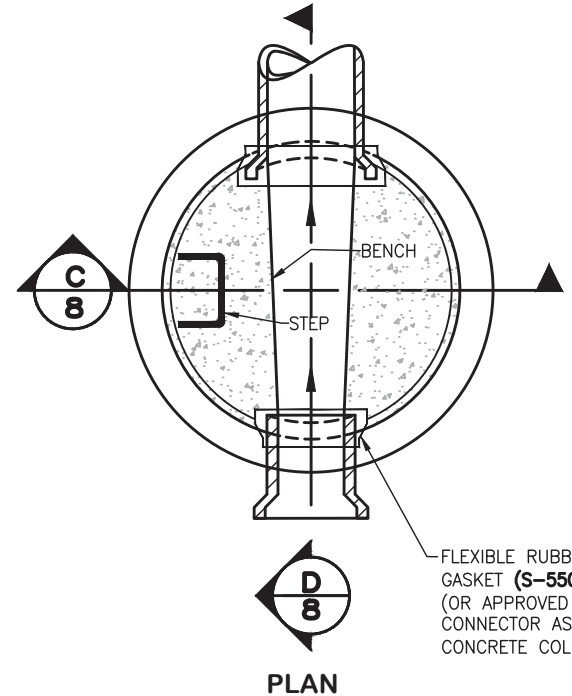


CAST-IN-PLACE MANHOLE BASE
(FOR SAN. (TYPE A) MH & STM. (TYPE C) MH)
NO SCALE

CAST-IN-PLACE MANHOLE BASE NOTES:

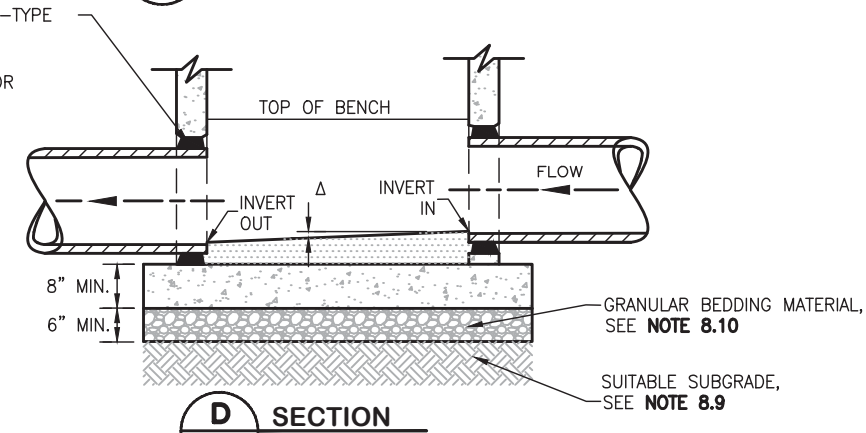
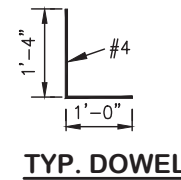
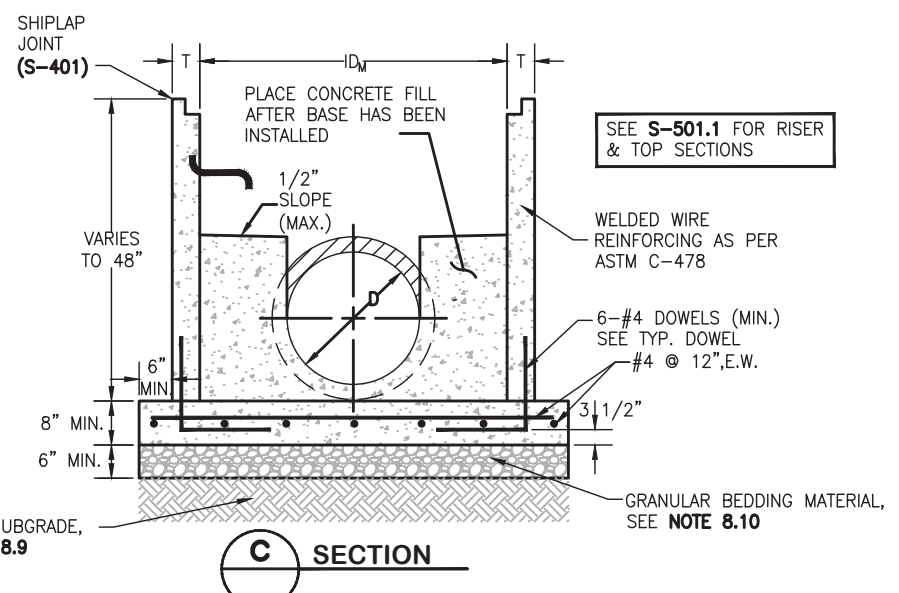
- 8.1 MANHOLE RISER MINIMUM DIAMETER SHALL CONFORM TO TABLE 6, S-501.1.
- 8.2 GROUTED FLOW CHANNELS AND INVERTS MAY BE FORMED BY SHAPING WITH LEAN CONCRETE ($f'_c=2000$ PSI MIN.), ALL OTHER CONCRETE SHALL BE MIN. $f'_c=4500$ PSI.
- 8.3 ALL DEAD END MANHOLES SHALL BE STUBBED THRU AT 0.40% MINIMUM SLOPE.
- 8.4 STUB-OUTS SHALL EXTEND 2'-0" MIN. PAST MANHOLE O.D. AND BE FACTORY PLUGGED.
- 8.5 REINFORCING IS REQUIRED FOR ALL MANHOLE BASES.
- 8.6 SLOPE MANHOLE BENCH 1/2" MAXIMUM TOWARD FLOW CHANNEL.
- 8.7 FOR SANITARY SEWERS, IF $\Delta \geq 18"$, AN OUTSIDE DROP MANHOLE IS REQUIRED (S-530).
- 8.8 SHIPLAP JOINTS ON MANHOLE BARREL RISER SHALL CONFORM TO DIVISION STANDARDS AND SPECIFICATIONS (S-401).
- 8.9 ALL MANHOLES & SPECIAL STRUCTURES TO BE PLACED ON SUITABLE SUBGRADE MATERIAL. IF SUBGRADE CONDITIONS WARRANT, UNSUITABLE FOUNDATION MATERIAL WILL BE OVEREXCAVATED, & SELECT SUBGRADE MATERIAL WILL BE PLACED AS PER SECTION 5.00 OF THE WCPM STANDARD CONSTRUCTION SPECIFICATIONS.
- 8.10 GRANULAR BEDDING MATERIAL SHALL BE COMPACTED TO 90% MAXIMUM DRY DENSITY IN ACCORDANCE WITH AASHTO T-180.
- 8.11 ALL PIPE OPENINGS SHALL BE CONSTRUCTED WITH AN APPROVED FLEXIBLE WEDGE-TYPE GASKET CONFORMING TO ASTM C-443 WHICH SHALL BE CAPABLE OF PROVIDING A WATER TIGHT JOINT WITH ZERO LEAKAGE AROUND THE INSTALLED PIPE. CONCRETE TO CONCRETE DONE WITHOUT WATER STOP GASKET FOR STORM SEWER WILL BE AT THE DISCRETION OF THE CITY (S-550).
- 8.12 ALL PRECAST RISER SECTIONS, CONES, GRADE RINGS, ETC. SHALL CONFORM TO THE LATEST REVISION OF ASTM C-478, STANDARD SPECIFICATION FOR CIRCULAR PRECAST REINFORCED CONCRETE MANHOLE SECTIONS.
- 8.13 NO MODIFICATIONS TO A CAST-IN-PLACE MANHOLE WILL BE ACCEPTED ONCE CASTED.

$f'_c = 4500$ PSI
 $f_y = 60,000$ PSI



PRECAST MANHOLE BASE NOTES:

- 8.14 THE BASE SLAB SHALL BE POURED MONOLITHICALLY WITH BOTTOM RISER SECTION.
- 8.15 PRECAST MANHOLE BASES SHALL FIT THE CONDITIONS AND LOCATIONS FOR WHICH THEY ARE INTENDED WITHOUT ANY FIELD MODIFICATIONS. ANY MANHOLE BASE WHICH REQUIRES FIELD CUTTING OR MODIFICATION IN ORDER TO FIT THE LOCATIONS INTENDED SHALL BE REJECTED BY THE CITY AND REMOVED AND REPLACED BY THE CONTRACTOR AT NO COST TO THE CITY.
- 8.16 AN APPROVED FLEXIBLE BOOT TYPE SLEEVE MAY ALSO BE USED FOR PRECAST INSTALLATIONS.
- 8.17 PRECAST MANHOLES CANNOT BE SHIPPED PRIOR TO 5 DAYS POST CASTING, AND CANNOT BE INSTALLED PRIOR TO 7 DAYS POST CASTING.
- 8.18 FOR CONNECTIONS INTO BLIND CORE WITHOUT BOOT, SEE DETAIL FOR CONNECTOR PIPE INTO WALL, S-450.

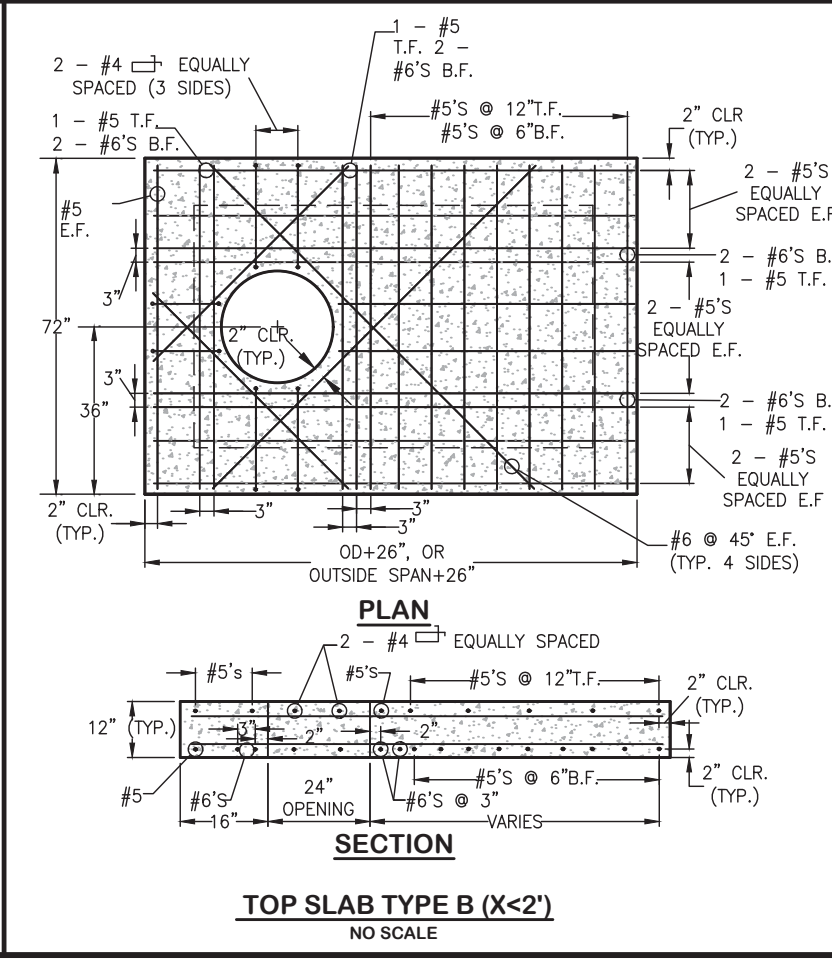
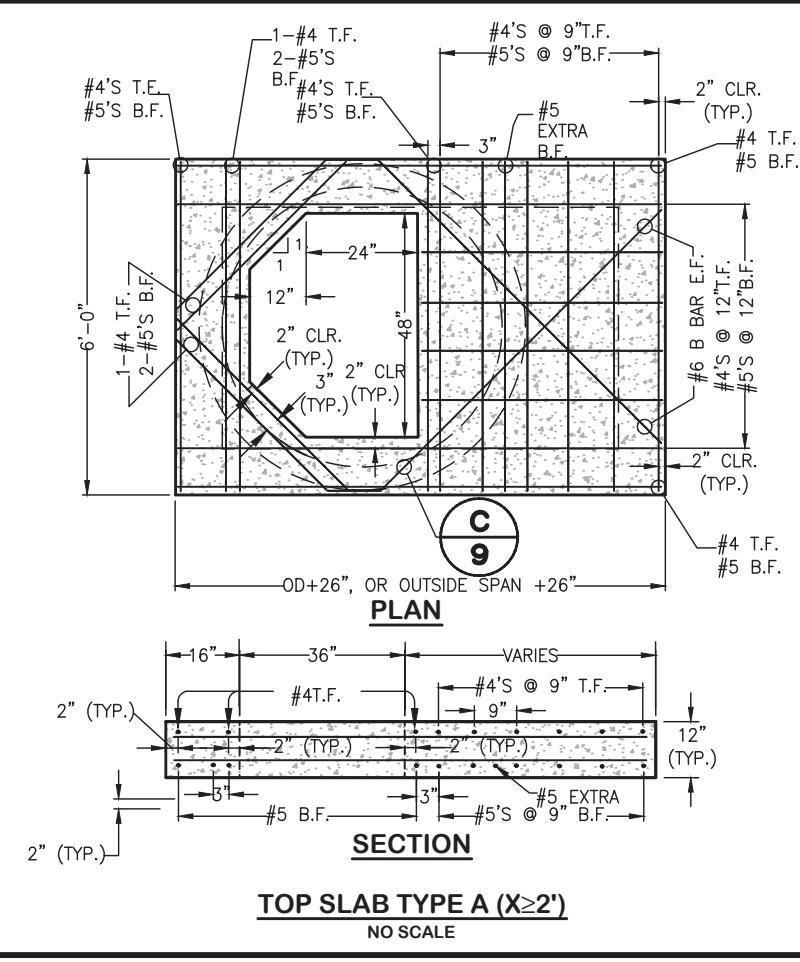
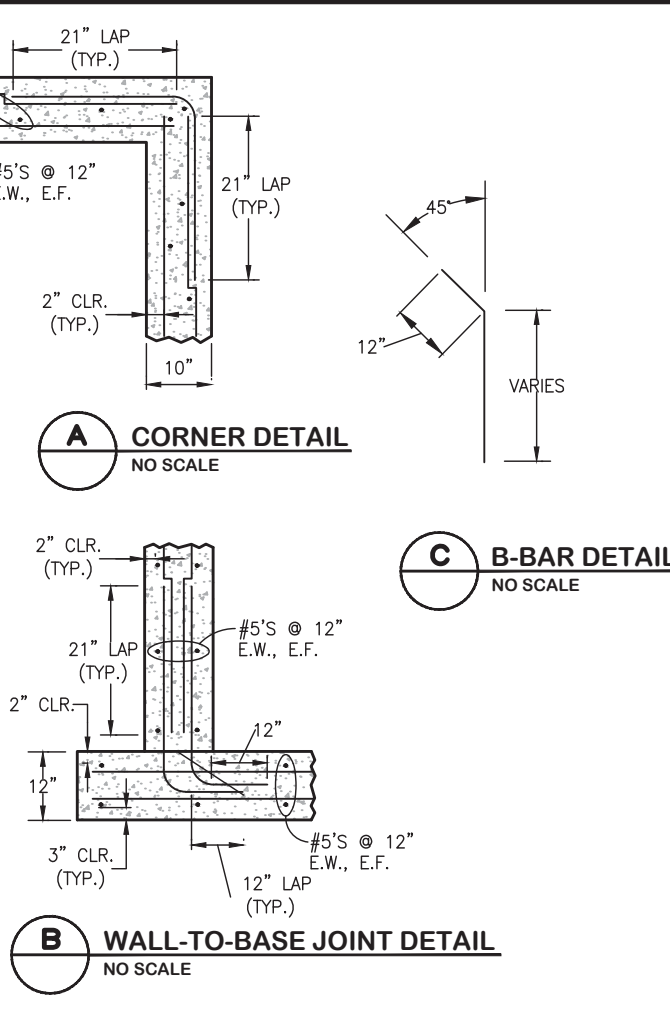
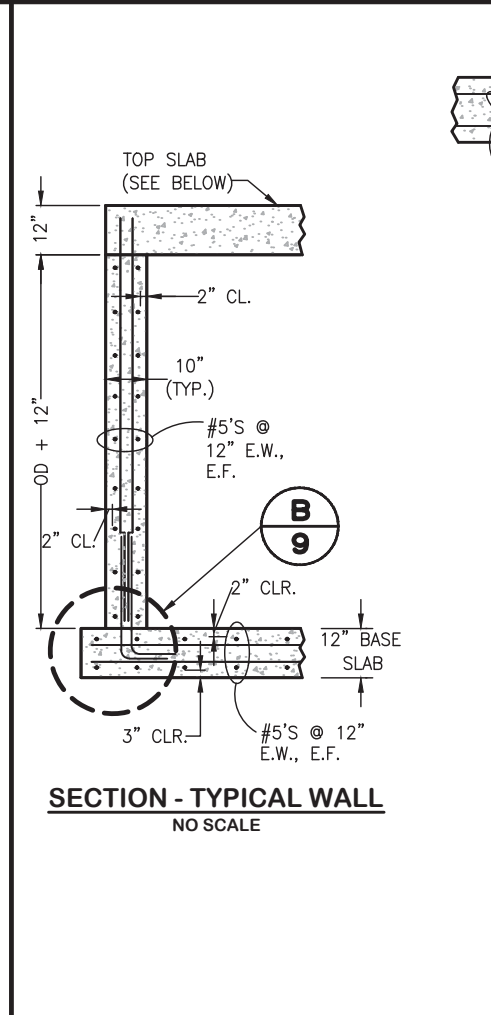
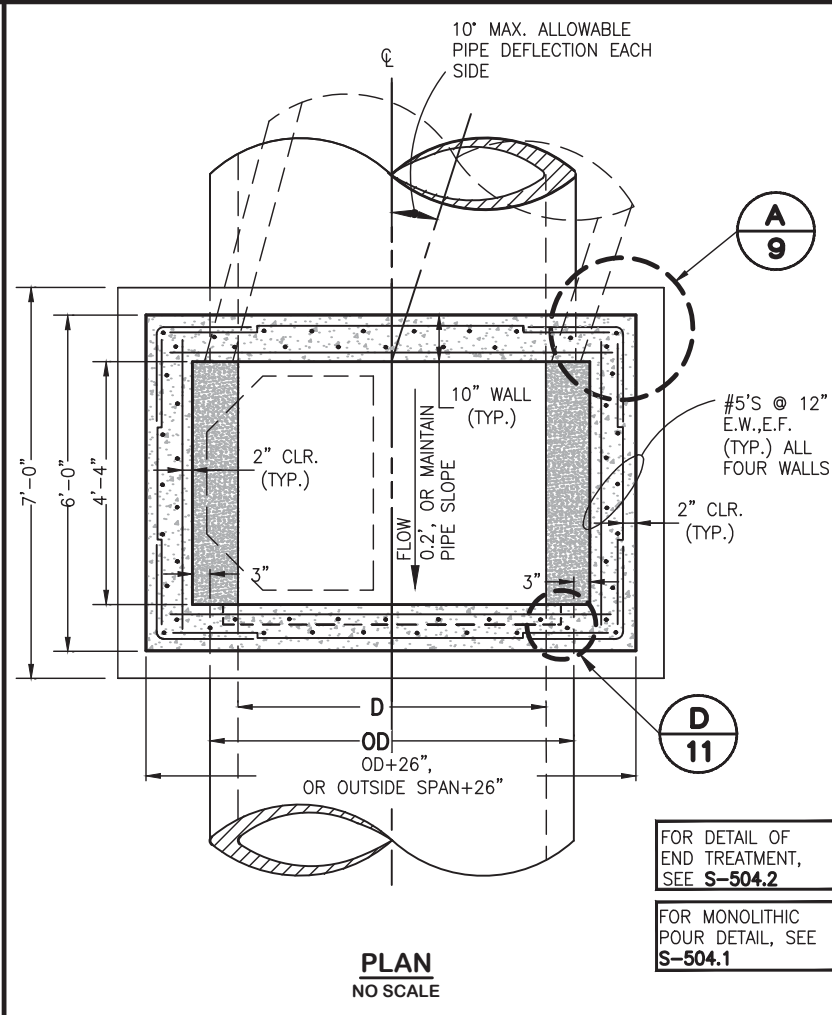
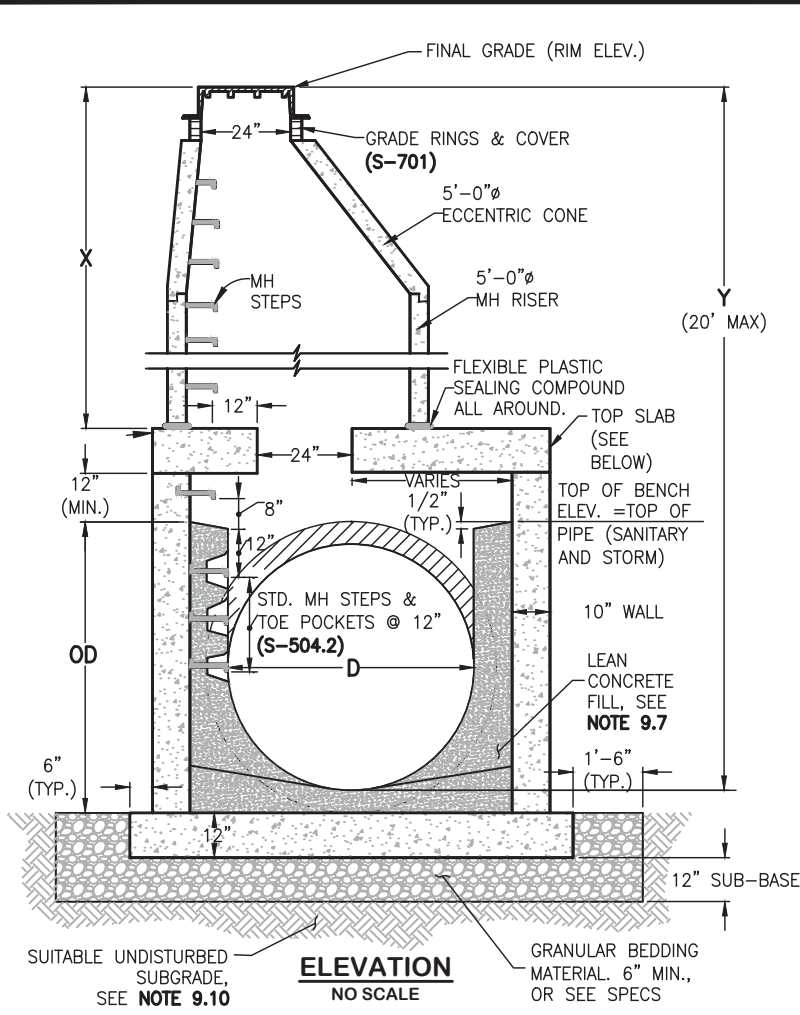


PRECAST MANHOLE BASE
(FOR SAN. (TYPE A) MH & STM. (TYPE C) MH)
NO SCALE

LEGEND
ID_M = INSIDE DIAMETER OF MANHOLE
T = MANHOLE WALL THICKNESS
 Δ = DROP THROUGH MANHOLE
D = INSIDE DIAMETER OF PIPE

PLOT DATE: May 1, 2020
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NO.	DESCRIPTION OF REVISIONS	DATE	BY
CITY AND COUNTY OF DENVER 2000 W. 3RD AVE. DENVER, CO 80223 www.denvergov.org			
STANDARD DETAILS		S-502	
MANHOLE BASE CONSTRUCTION - TYPE A AND C			
DRAWN BY:		KRC	
DESIGNED BY:		---	
APPROVED BY:		---	
DRAWING NAME:		S502.dwg	
DATE:		JUNE 2020	
SHEET NO.:		8	



TYPE B MANHOLE NOTES:

- THIS STANDARD MANHOLE DETAIL IS APPLICABLE TO CIRCULAR PIPES WITH 42" I.D. AND LARGER, AND NON-CIRCULAR PIPES WITH A SPAN OF 42" I.D. AND LARGER.
- PIPES ENTERING THE MANHOLE MAY BE DEFLECTED UP TO 10" (MAXIMUM) EACH PIPE FOR A TOTAL CHANGE OF DIRECTION OF FLOW OF 20° (MAXIMUM).
- FOR "Y" DEPTH OVER 20' SHOP DRAWINGS ALONG WITH CALCULATIONS FOR DESIGN OF WALLS, TOP AND BASE SLAB SHALL BE SUBMITTED FOR APPROVAL.
- SET TOP SLAB TYPE B ELEVATION NO MORE THAN 12"± BELOW FINISHED GRADE I.E. ALLOW ENOUGH COVER TO ADD MH RINGS AND COVER.
- PRECAST MANHOLE RISERS AND TOP SECTIONS SHALL CONFORM TO ASTM C-478. IN ADDITION MANHOLE STEPS, RISERS, SHIPLAP JOINTS, RING AND COVER SHALL CONFORM TO APPLICABLE WMD STANDARD DETAILS.
- CONCRETE IN TOP SLAB AND WALLS SHALL BE CLASS D CONCRETE AND HAVE A 28 DAY STRENGTH OF 4500 PSI. PERMISSIBLE SLUMP WILL BE 3" TO 5", AND AIR ENTRAINMENT WILL BE 5% - 8%.
- LEAN CONCRETE FILL SHALL HAVE A 28 DAY STRENGTH OF 2000 PSI. (TYPE II CEMENT).
- REINFORCING STEEL BARS SHALL CONFORM TO ASTM A-615 GRADE 60 DEFORMED BARS. CLEAR COVER REQUIREMENT (UNLESS OTHERWISE NOTED) TO BE 2" (3" FROM BOTTOM OF FOUNDATION SLAB.) REINFORCING BARS WILL BE SPICED ONLY AT LOCATIONS SHOWN AND DETAILED ON THE DRAWINGS. BARS WILL BE WIRE-TIED, NO TACK WELDING WILL BE PERMITTED.
- ALL STRUCTURES SHALL BE BENCHED TO TOP OF PIPE.
- ALL MANHOLES & SPECIAL STRUCTURES TO BE PLACED ON SUITABLE SUBGRADE MATERIAL. IF SUBGRADE CONDITIONS WARRANT, UNSUITABLE FOUNDATION MATERIAL WILL BE OVEREXCAVATED, & SELECT SUBGRADE MATERIAL WILL BE PLACED AS PER SECTION 5.00 OF THE WCPM STANDARD CONSTRUCTION SPECIFICATIONS.
- GRANULAR BEDDING MATERIAL SHALL BE COMPACTED TO 90% MAXIMUM DRY DENSITY IN ACCORDANCE WITH AASHTO T-180.
- STRUCTURE WALLS SHALL BE FORMED BOTH INSIDE AND OUTSIDE. CASTING OF SIDEWALLS AGAINST EARTH IS NOT PERMITTED.
- LATERAL SUPPORT SHALL BE PROVIDED AND MAINTAINED FOR WALLS DURING BACKFILLING OPERATIONS.
- MAX LATERAL SHALL BE 24" OR SMALLER. IF LARGER, A SPECIAL STRUCTURAL DESIGN IS REQUIRED. SEE S-616.3 FOR PENETRATION DETAIL.

LEGEND
ID= INSIDE DIAMETER OF MANHOLE
OD= OUTSIDE DIAMETER OF PIPE
D= INSIDE DIAMETER OF PIPE
X= DEPTH OF MANHOLE RISER
Y= TOTAL DEPTH OF MANHOLE

LEGEND, CONT.
T.F.= TOP FACE
B.F.= BOTTOM FACE
E.F.= EACH FACE
E.W.= EACH WAY

PLOT DATE: May 1, 2020
S:\STAFF_FOLDERS\CRUM\WATERMAIN STANDARD DETAILS\REVISED 2016\503.DWG

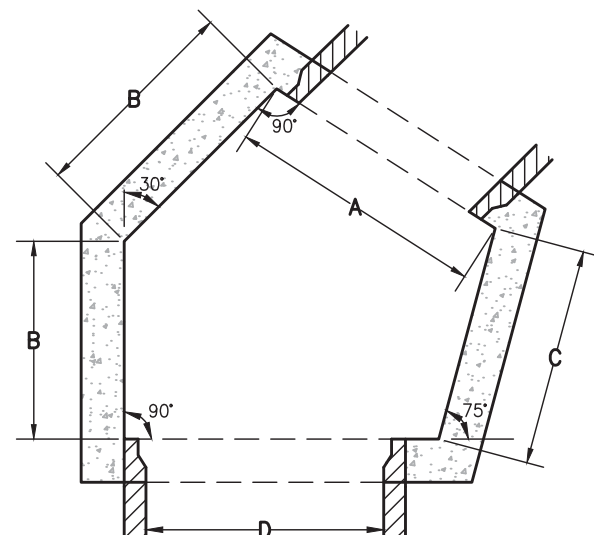
NO.	DESCRIPTION OF REVISIONS	BY	DATE

DENVER
THE MILE HIGH CITY

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2000 W. 3RD AVE. DENVER, CO 80223
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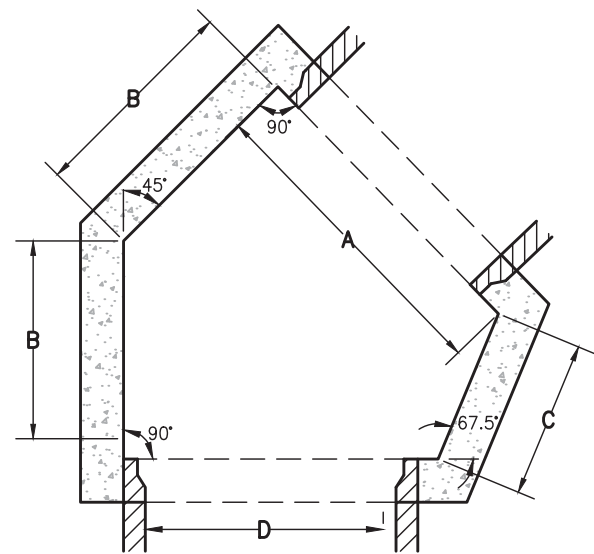
STANDARD DETAILS
TYPE B MANHOLE
S-503

DRAWN BY: KRC
DESIGNED BY: ---
APPROVED BY: ---
DRAWING NAME: S503.dwg
DATE: JUNE 2020
SHEET NO.: 9



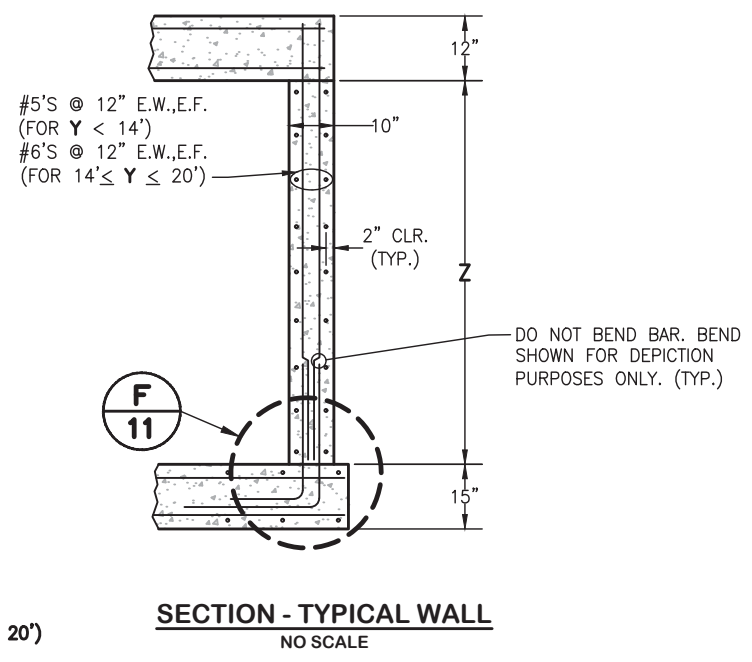
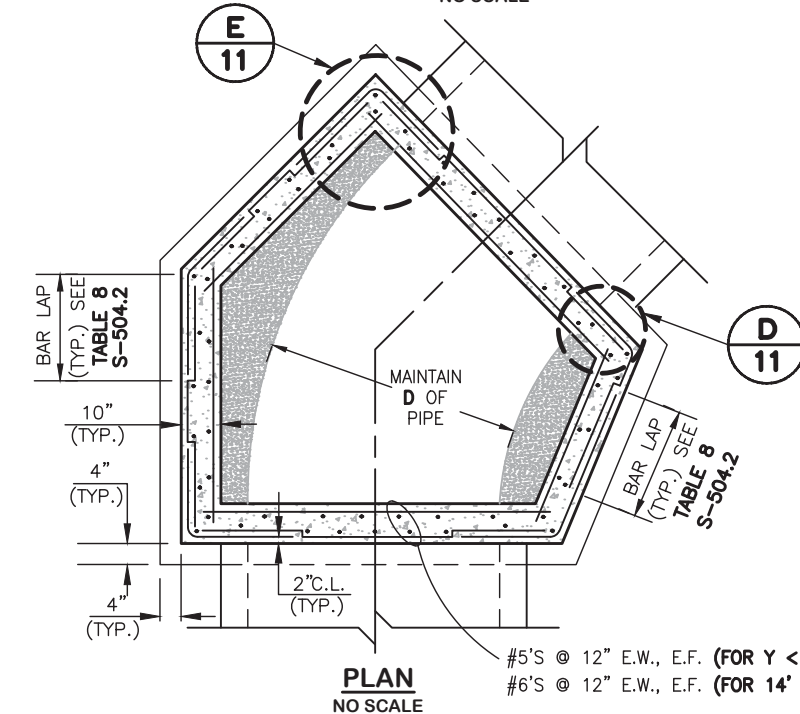
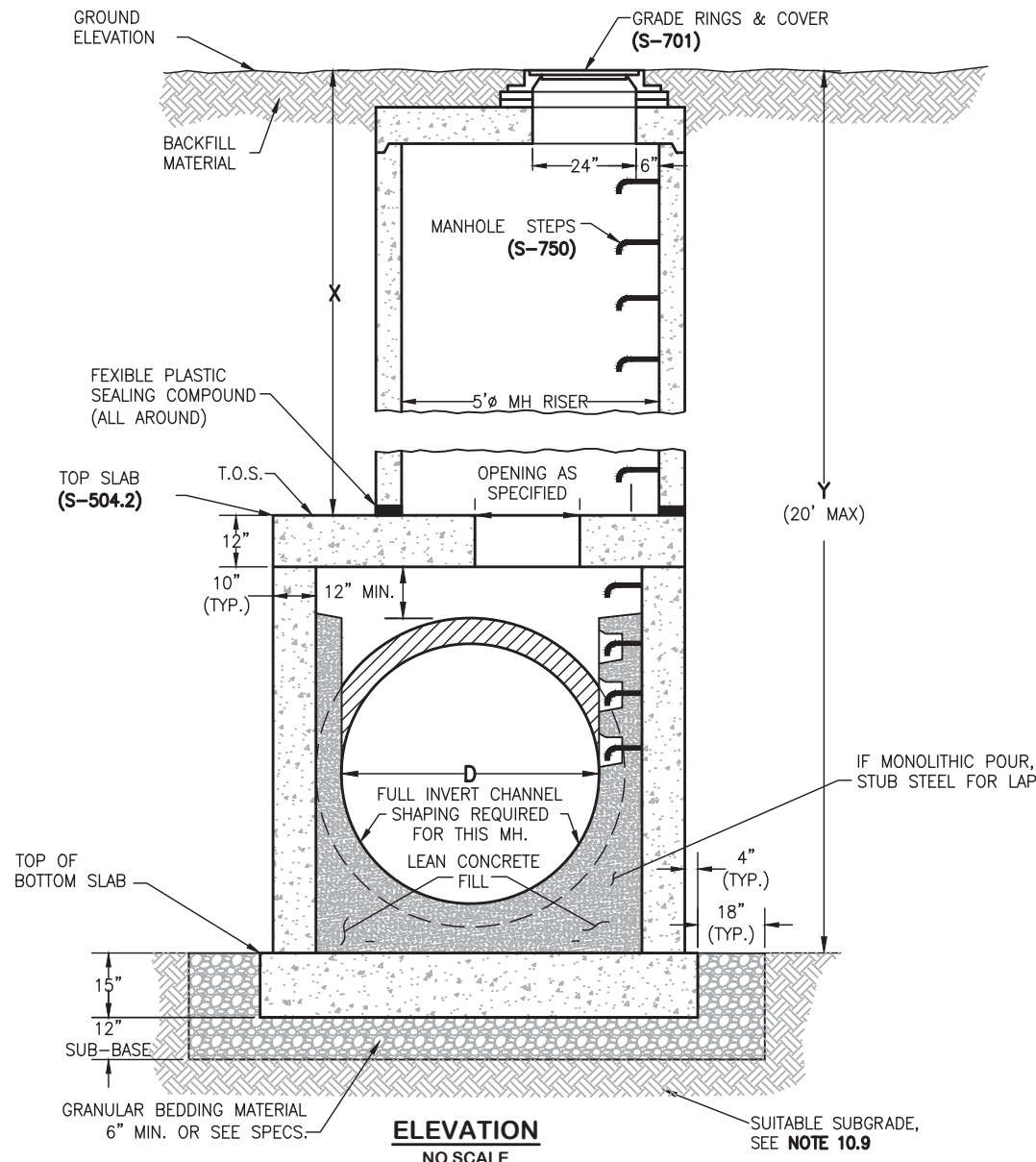
STRUCTURE PLAN VIEW - 30° BEND
NO SCALE

PIPE SIZE	A	B	C
42"	4' - 6"	3' - 4"	4' - 2"
48"	5' - 1"	3' - 6"	4' - 2"
54"	5' - 8"	3' - 8"	4' - 2"
60"	6' - 3"	3' - 10"	4' - 2"
66"	6' - 10"	4' - 0"	4' - 2"
72"	7' - 5"	4' - 2"	4' - 2"
78"	8' - 0"	4' - 4"	4' - 2"



STRUCTURE PLAN VIEW - 45° BEND
NO SCALE

PIPE SIZE	A	B	C
42"	4' - 6"	3' - 6"	3' - 0"
48"	5' - 1"	3' - 9"	3' - 0"
54"	5' - 8"	4' - 0"	3' - 0"
60"	6' - 3"	4' - 3"	3' - 0"
66"	6' - 10"	4' - 6"	3' - 0"
72"	7' - 5"	4' - 9"	3' - 0"
78"	8' - 0"	5' - 0"	3' - 0"



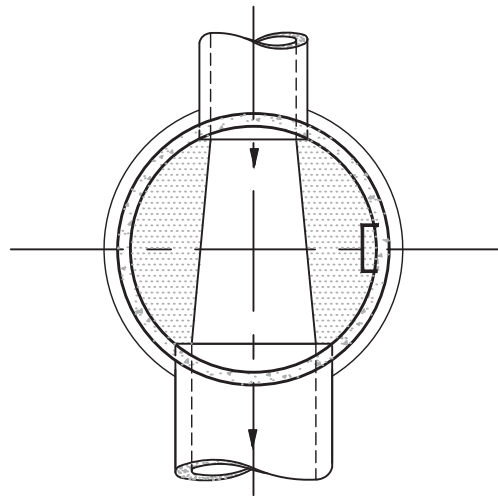
TYPE P MANHOLE NOTES:

- THIS STANDARD MANHOLE DETAIL IS APPLICABLE TO CIRCULAR PIPES WITH 42" I.D. AND LARGER, AND NON-CIRCULAR PIPES WITH A SPAN OF 42" I.D. AND LARGER.
- FOR "Y" DEPTH OVER 20' SHOP DRAWINGS ALONG WITH CALCULATIONS FOR DESIGN OF WALLS, TOP AND BASE SLAB SHALL BE SUBMITTED FOR APPROVAL.
- SET TOP SLAB TYPE B ELEVATION NO MORE THAN 12"± BELOW FINISHED GRADE I.E. ALLOW ENOUGH COVER TO ADD MH RINGS AND COVER.
- PRECAST MANHOLE RISERS AND TOP SECTIONS SHALL CONFORM TO ASTM C-478. IN ADDITION MANHOLE STEPS, RISERS, SHIPLAP JOINTS, RING AND COVER SHALL CONFORM TO APPLICABLE WMD STANDARD DETAILS.
- CONCRETE IN TOP SLAB AND WALLS SHALL BE CLASS D CONCRETE AND HAVE A 28 DAY STRENGTH OF 4500 PSI. PERMISSIBLE SLUMP WILL BE 3" TO 5", AND AIR ENTRAINMENT WILL BE 5% - 8%.
- LEAN CONCRETE FILL SHALL HAVE A 28 DAY STRENGTH OF 2000 PSI. (TYPE II CEMENT).
- REINFORCING STEEL BARS SHALL CONFORM TO ASTM A-615 GRADE 60 DEFORMED BARS. CLEAR COVER REQUIREMENT (UNLESS OTHERWISE NOTED) TO BE 2" (3" FROM BOTTOM OF FOUNDATION SLAB.) REINFORCING BARS WILL BE SPLICED ONLY AT LOCATIONS SHOWN AND DETAILED ON THE DRAWINGS. BARS WILL BE WIRE-TIED, NO TACK WELDING WILL BE PERMITTED.
- ALL STRUCTURES SHALL BE BENCHED TO TOP OF PIPE.
- ALL MANHOLES & SPECIAL STRUCTURES TO BE PLACED ON SUITABLE SUBGRADE MATERIAL. IF SUBGRADE CONDITIONS WARRANT, UNSUITABLE FOUNDATION MATERIAL WILL BE OVEREXCAVATED, & SELECT SUBGRADE MATERIAL WILL BE PLACED AS PER SECTION 5.00 OF THE WCPM STANDARD CONSTRUCTION SPECIFICATIONS.
- GRANULAR BEDDING MATERIAL SHALL BE COMPACTED TO 90% MAXIMUM DRY DENSITY IN ACCORDANCE WITH AASHTO T-180
- STRUCTURE WALLS SHALL BE FORMED BOTH INSIDE AND OUTSIDE. CASTING OF SIDEWALLS AGAINST EARTH IS NOT PERMITTED.
- LATERAL SUPPORT SHALL BE PROVIDED AND MAINTAINED FOR WALLS DURING BACKFILLING OPERATIONS.
- MAX LATERAL SHALL BE 24" OR SMALLER. IF LARGER, A SPECIAL STRUCTURAL DESIGN IS REQUIRED. SEE S-616.3 FOR PENETRATION DETAIL.
- SEE S-504.2 FOR REINFORCEMENT DETAILS.

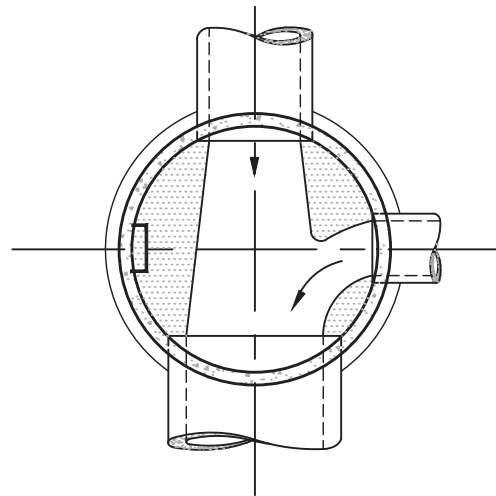
S:\STAFF_FOLDERS\CRUM\WASTEWATER STANDARD DETAILS\REVISED 2019\S504-1.DWG PLOT DATE: May 1, 2020

NO.	DATE	BY	
DESCRIPTION OF REVISIONS			
 DENVER THE MILE HIGH CITY			
CITY AND COUNTY OF DENVER 2000 W. 3RD AVE. DENVER, CO 80223 www.denvergov.org			
STANDARD DETAILS		TYPE P MANHOLE	
S-504.1		S-504.1	
DRAWN BY: KRC DESIGNED BY: --- APPROVED BY: --- DRAWING NAME: S504-1.dwg DATE: JUNE 2020 SHEET NO.: 10			

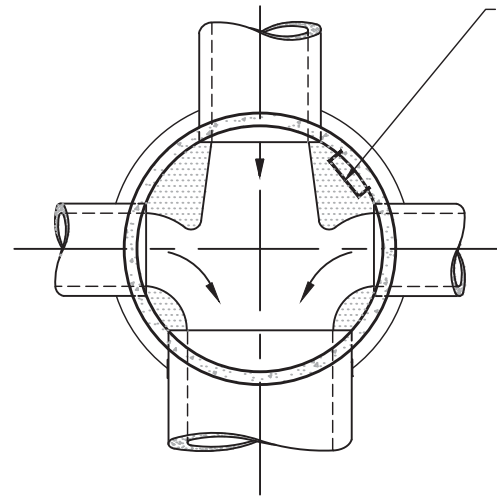
D=	INSIDE DIAMETER OF PIPE
X=	DEPTH OF MANHOLE RISER
Y=	TOTAL DEPTH OF MANHOLE
E.F.=	EACH FACE
E.W.=	EACH WAY



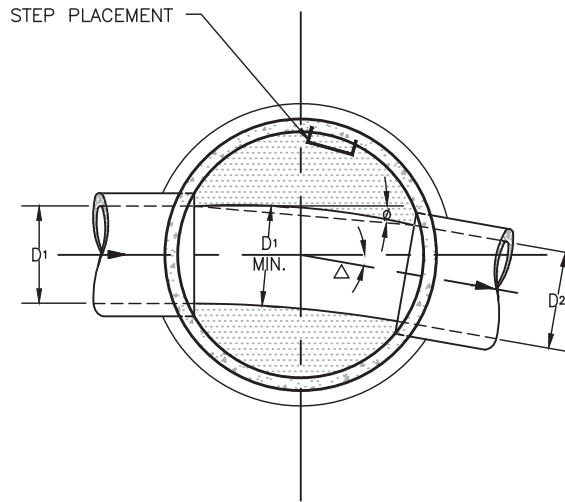
THROUGH PIPE
NO SCALE



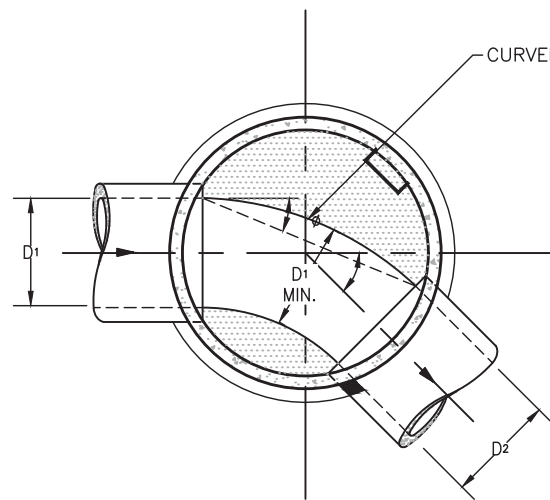
THROUGH PIPE - ONE LATERAL
NO SCALE



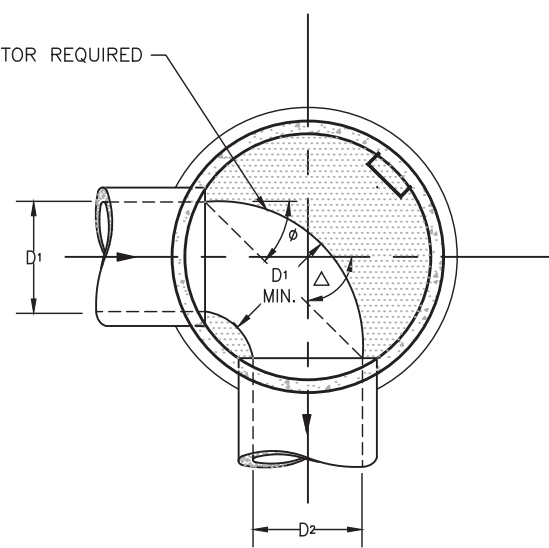
THROUGH PIPE - TWO LATERALS
NO SCALE



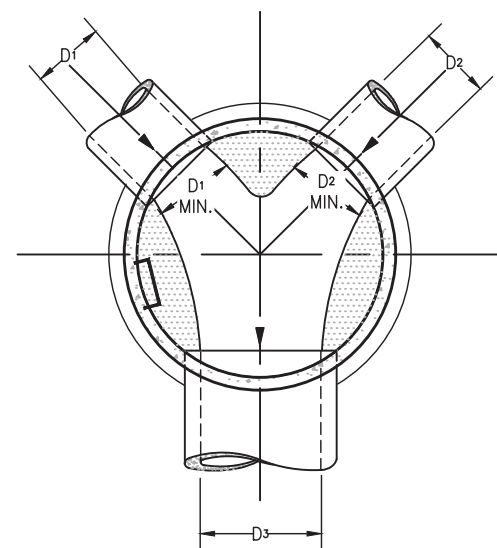
SLIGHT ANGLE
NO SCALE
 $\phi \leq 15^\circ$
 $\Delta \leq 30^\circ$



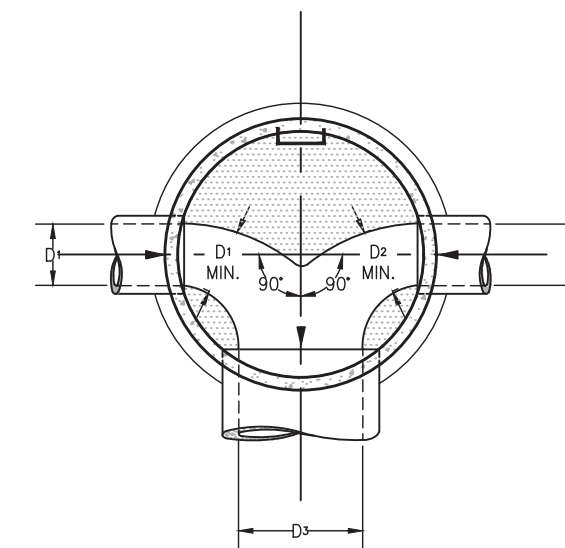
INTERMEDIATE ANGLE
NO SCALE
 $\phi = \frac{\Delta}{2}$
 $30^\circ < \Delta < 90^\circ$



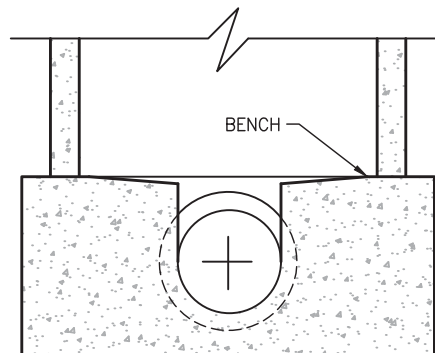
SHARP ANGLE
NO SCALE
 $\phi = 45^\circ$
 $\Delta = 90^\circ$



ANGLED LATERALS
NO SCALE



OPPOSED LATERALS
NO SCALE



IDEAL MH CHANNEL SECTION
NO SCALE

CHANNELIZATION NOTES:

- 12.1 DETAILS SHOWN ARE TYPICAL ONLY FOR INSTALLATIONS WITH ALL INVERTS AT SAME RELATIVE ELEVATION.
- 12.2 FOR EXCESSIVE ELEVATION DIFFERENCE BETWEEN INVERTS, ETC. SPECIAL BASE/CHANNEL DETAILS SHALL BE SHOWN ON PLANS.
- 12.3 CHANNELIZATION DETAILS & STEP PLACEMENT TYPICAL FOR BOTH STORM AND SANITARY SEWER MH'S.
- 12.4 THE MINIMUM VERTICAL DROP THRU MANHOLE BASE SHALL BE 0.10 FOOT FOR STORM SEWERS AND 0.2 FOOT FOR SANITARY SEWER.
- 12.5 FOR SANITARY SEWER, VERTICAL DROPS IN EXCESS OF 18" REQUIRE AN OUTSIDE DROP. SEE **S-530**.

NO.	DESCRIPTION OF REVISIONS	DATE	BY

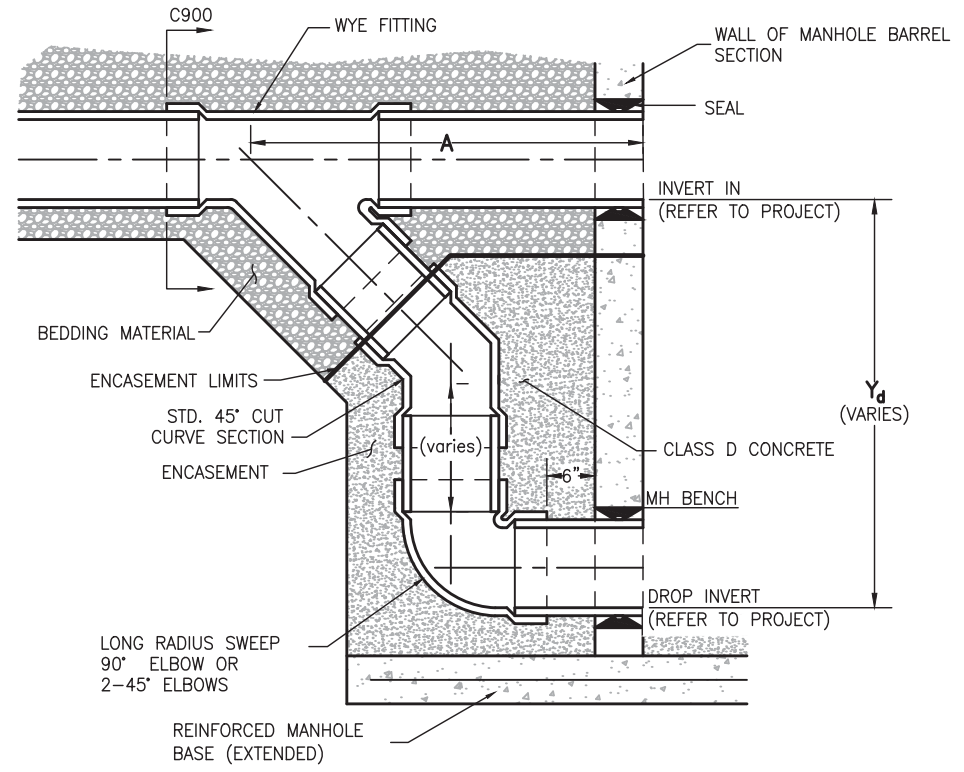


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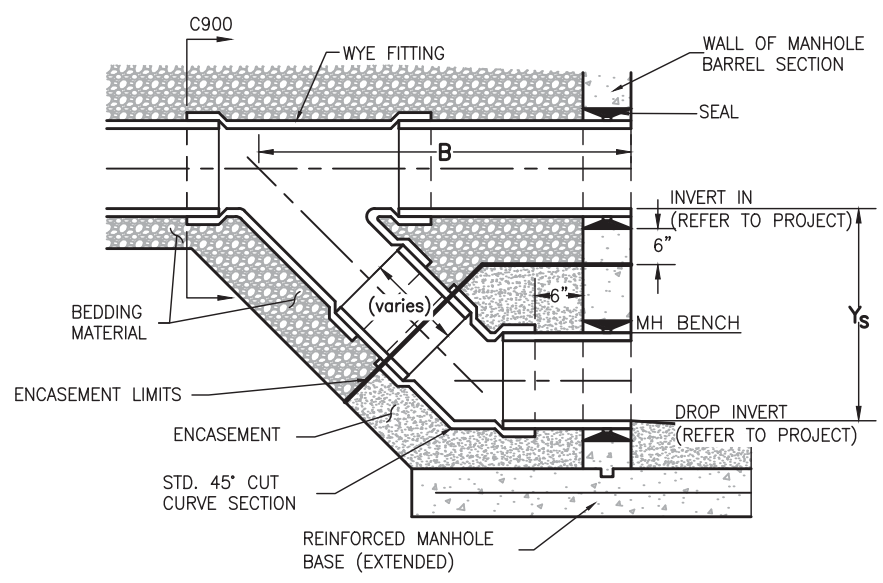
STANDARD DETAILS
TYPICAL MANHOLE BASE
CHANNELIZATION

S-520

DRAWN BY:	KRC
DESIGNED BY:	
APPROVED BY:	
DRAWING NAME:	SS20.dwg
DATE:	JUNE 2020
SHEET NO.:	12



DEEP DROP



SHALLOW DROP

**MANHOLE OUTSIDE DROP
FOR PIPE DIAMETER LESS THAN 18"
NO SCALE**

MANHOLE OUTSIDE DROP NOTES:

- 13.1 OUTSIDE DROP REQUIRED FOR ANY DROP GREATER THAN 18".
- 13.2 ALL PIPE AND FITTINGS TO BE ASTM AND CITY APPROVED.
- 13.3 FOR PAYMENT PURPOSES, ALL FITTINGS, PIPE, CONCRETE ENCASEMENT SHALL BE INCLUDED IN THE UNIT PRICE OF THE OUTSIDE DROP.
- 13.4 DIAMETER OF THE PIPE SHALL NOT BE LESS THAN MAIN LINE PIPE DIAMETER.
- 13.5 FOR 18" DIAMETER AND LARGER, OUTSIDE DROP SHALL BE A SPECIAL DESIGN.
- 13.6 THE APPROPRIATE MH SEAL, ADAPTOR OR CONNECTOR SHALL BE USED FOR THE SPECIFIED PIPE MATERIAL, AND SHALL BE APPROVED BY THE CITY.
- 13.7 OUTSIDE DROP SHALL BE CONSTRUCTED OF C900 PVC.
- 13.8 CONCRETE ENCASEMENT SHALL BE A MINIMUM OF 6" THICK ALL AROUND.
- 13.9 PIPE DIMENSIONS ARE APPROXIMATE AND MAY VARY FROM ONE MANUFACTURER TO ANOTHER.
- 13.10 ALL REQUIRED WALL OPENINGS SHALL BE PRECAST BLOCK-OUTS OR CORE DRILLED. JACK HAMMERING OF OPENINGS IS NOT ALLOWED.

TABLE 9. MINIMUM DROP DIMENSIONS FOR PVC PIPE

DIMENSIONS (NOMINAL)	A				B				Y _d				Y _s			
PIPE DIAMETER (INCHES)	8	10	12	16	8	10	12	16	8	10	12	16	8	10	12	16
MIN. DIMENSIONS (INCHES)	42	47	49	65	41	43	51	61	31	37	39	55	18	18	22	28

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NO.	DESCRIPTION OF REVISIONS	DATE	BY

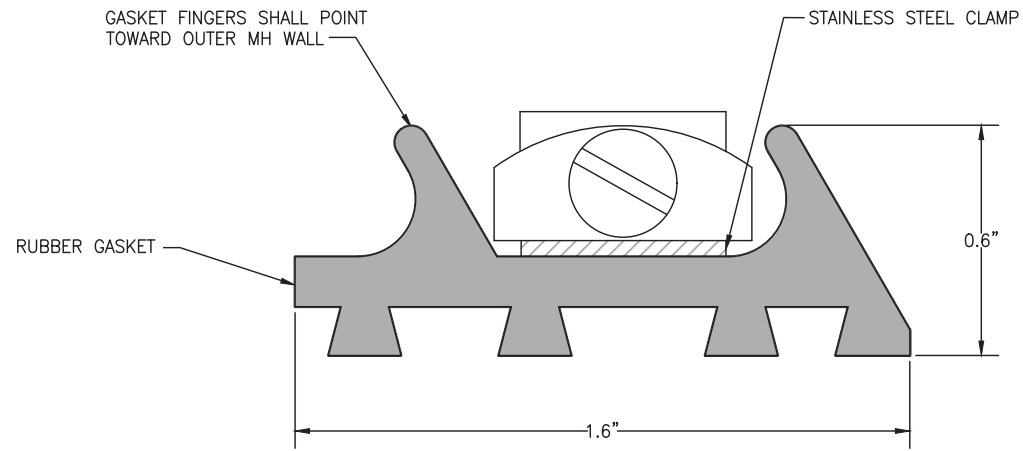


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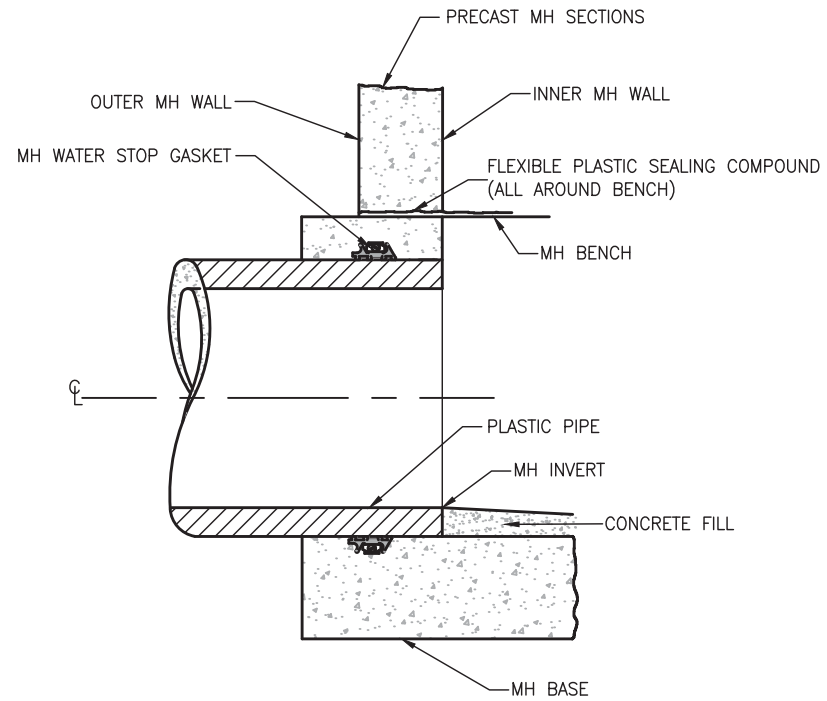
STANDARD DETAILS
SANITARY SEWER
MANHOLE OUTSIDE DROP

S-530

DRAWN BY:	KRC
DESIGNED BY:	
APPROVED BY:	
DRAWING NAME:	SS530.dwg
DATE:	JUNE 2020
SHEET NO.:	13

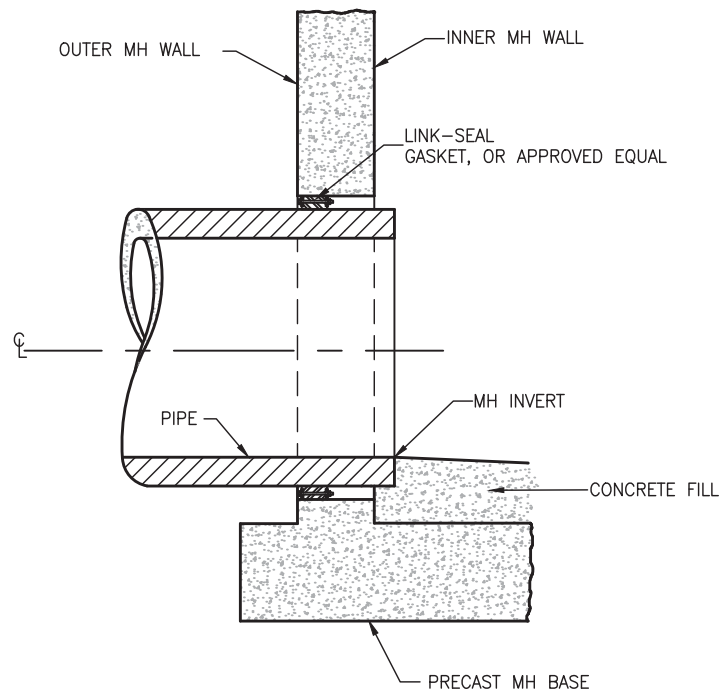


MH WATER STOP GASKET



CAST-IN-PLACE MANHOLE CONNECTION DETAILS FOR DISSIMILAR PIPE (NON-POROUS PIPE)

NO SCALE



PRECAST MANHOLE CONNECTION DETAILS FOR ANY TYPE OF PIPE

NO SCALE

WATER STOP GASKET NOTES:

- 14.1 PLACE STOP ON PIPE NEAR CENTER OF MANHOLE WALL.
- 14.2 TIGHTEN STEEL BAND TO ASSURE POSITIVE SEAL AGAINST PIPE OUTSIDE. A SCREWDRIVER MAY BE USED TO TAKE UP INITIAL SLACK BUT A SOCKET WRENCH (5/16") IS PREFERRED TO ENSURE PROPER TIGHTNESS.
- 14.3 CONSEAL (RAM NECK) IS NOT ACCEPTABLE.
- 14.4 HYDROTITE LEAKMASTER, SWELLSTOP, OR APPROVED EQUAL MAY BE USED FOR LARGE DIAMETER PIPE 60" OR GREATER AT THE DISCRETION OF THE CITY.

PLOT DATE: May 1, 2020

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NO.	DESCRIPTION OF REVISIONS	DATE	BY



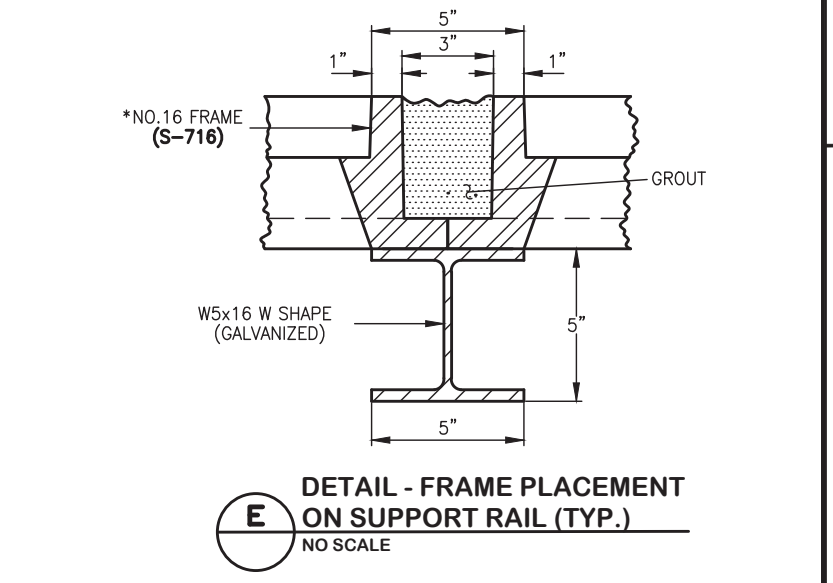
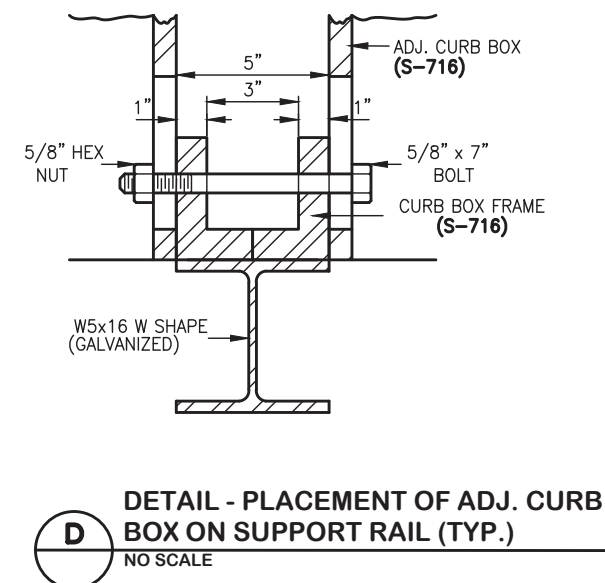
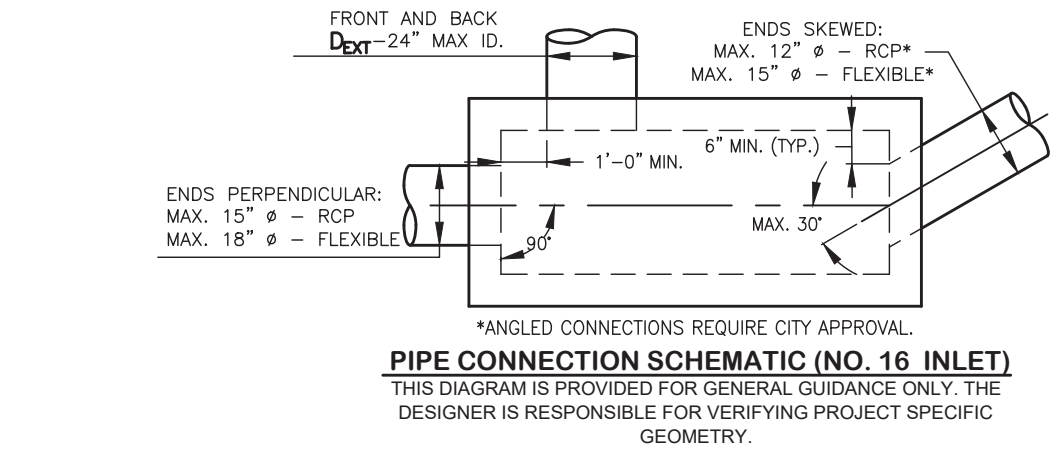
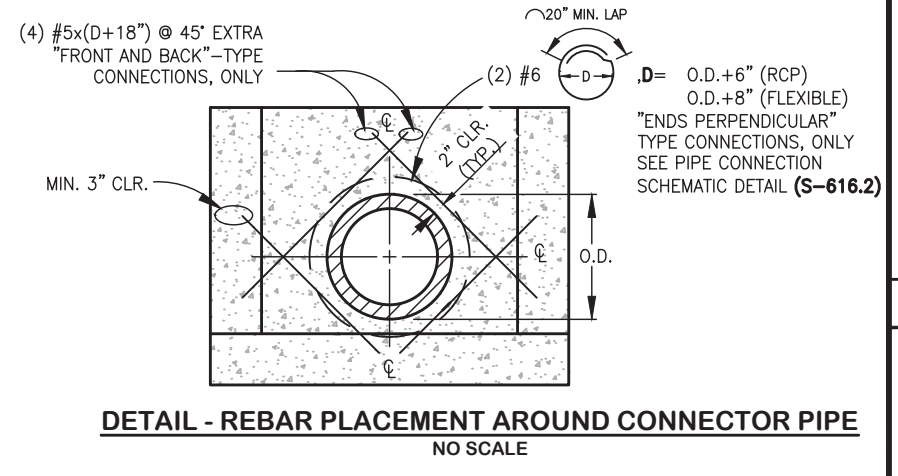
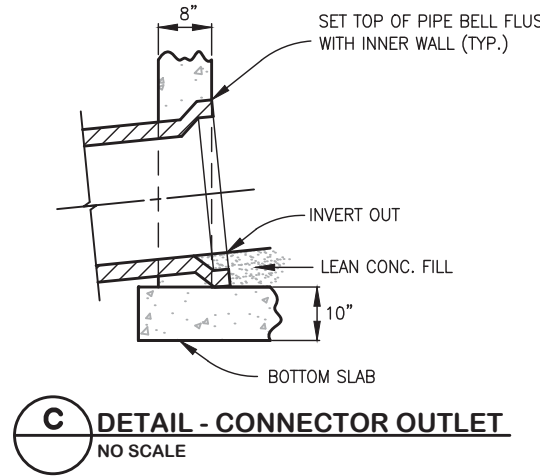
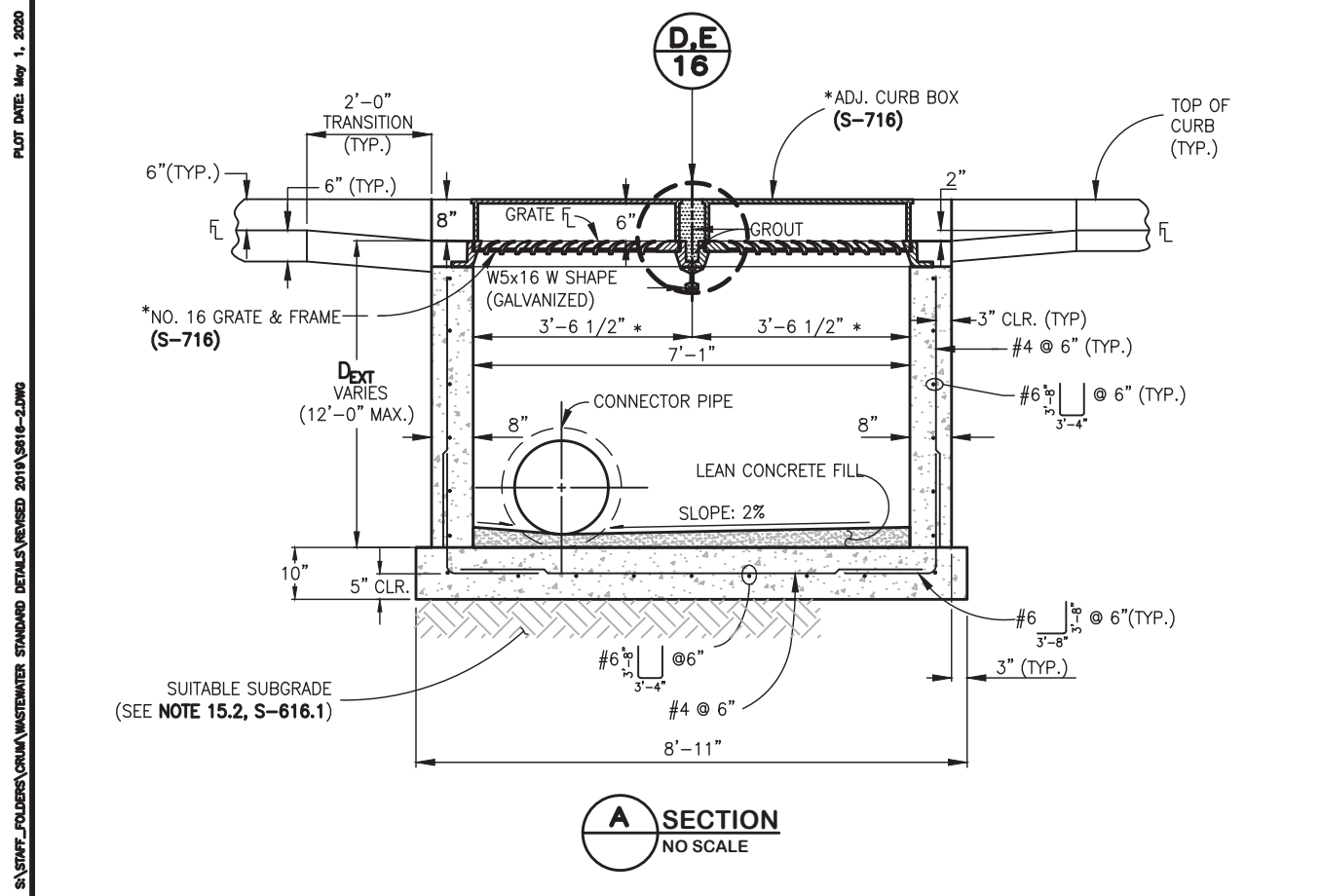
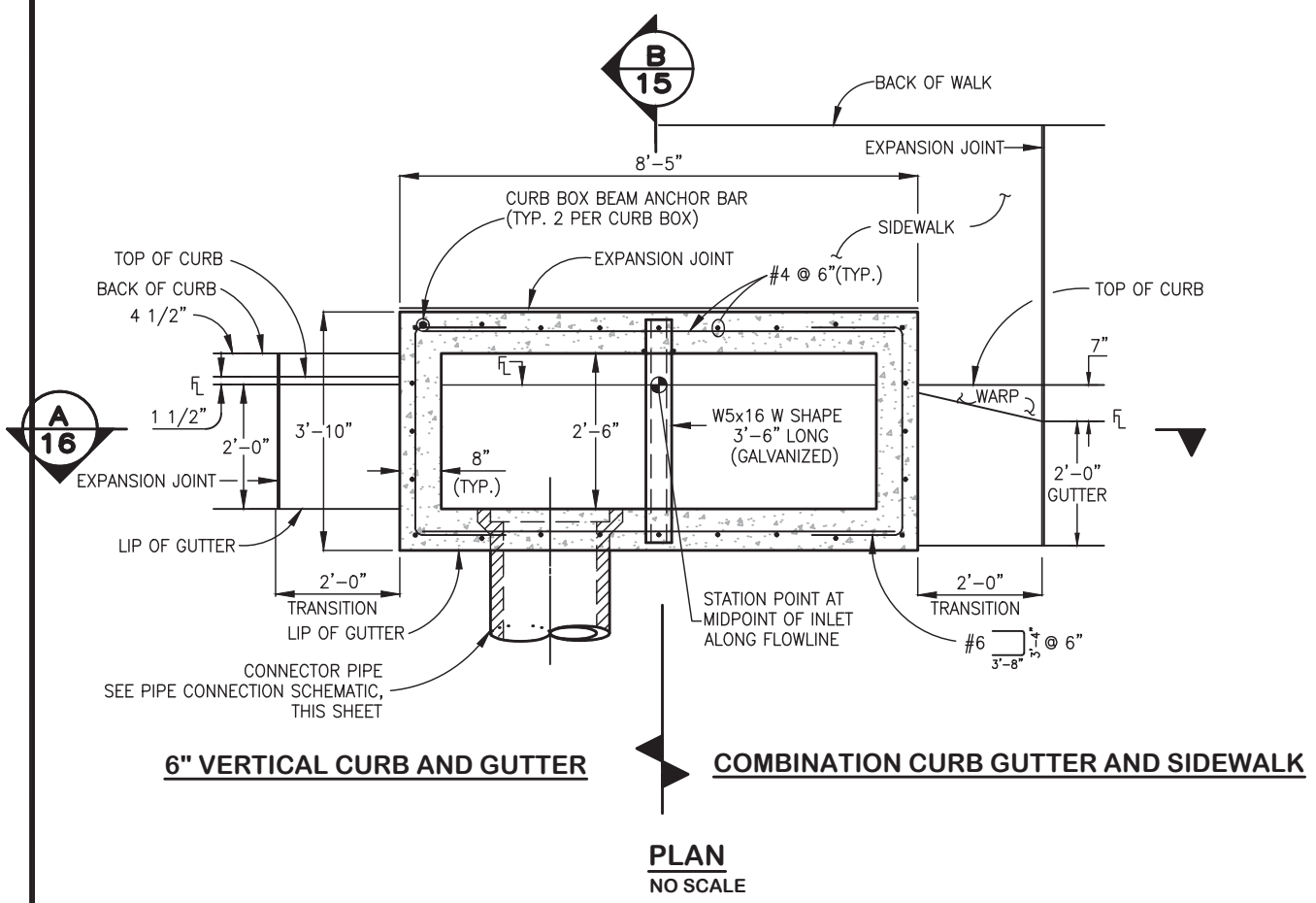
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STANDARD DETAILS
WATER STOP GASKET

S-550

DRAWN BY: KRC
DESIGNED BY:
APPROVED BY:
DRAWING NAME: S550.dwg
DATE: JUNE 2020
SHEET NO.:

SA STAFF FOLDER/CURB/WASTEWATER STANDARD DETAILS/REVISED 2016/S-616-2.DWG
 PLOT DATE: May 1, 2020



DOUBLE NUMBER 16 INLET NOTES:

- SEE DETAIL SPECIFICATIONS SECTION 11.05 STORM INLETS FOR MORE INFORMATION. USE OF THIS DETAIL WITHOUT SPECIFICATIONS SHALL BE CONSIDERED NON-COMPLIANT.
- SEE GENERAL NOTES ON **S-616.1**.
- EXPANSION JOINT MATERIAL SHALL BE PLACED FULL DEPTH OF THE CURB AND GUTTER, SIDEWALK, CONCRETE PAVEMENT, AS APPLICABLE. THE TOP PORTION OF THE JOINT SHALL BE SEALED WITH SILICONE SEALANT.
- SEE **S-616.1** FOR REBAR PLACEMENT AT WALL PENETRATION DETAIL.

* STANDARD DETAIL **S-716** APPLIES TO ALL OF THE GRATE & FRAME GEOMETRIC DIMENSIONS FOR THE DOUBLE NUMBER 16 INLET EXCEPT FOR THE FRAME LENGTH. FRAME LENGTH SHOULD BE MANUFACTURED FOR THE DIMENSIONS CALLED OUT ON THIS SHEET.

NO.	DESCRIPTION OF REVISIONS	DATE	BY

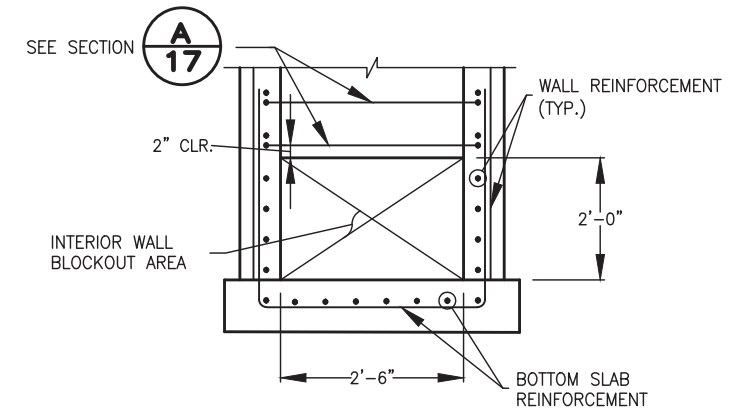
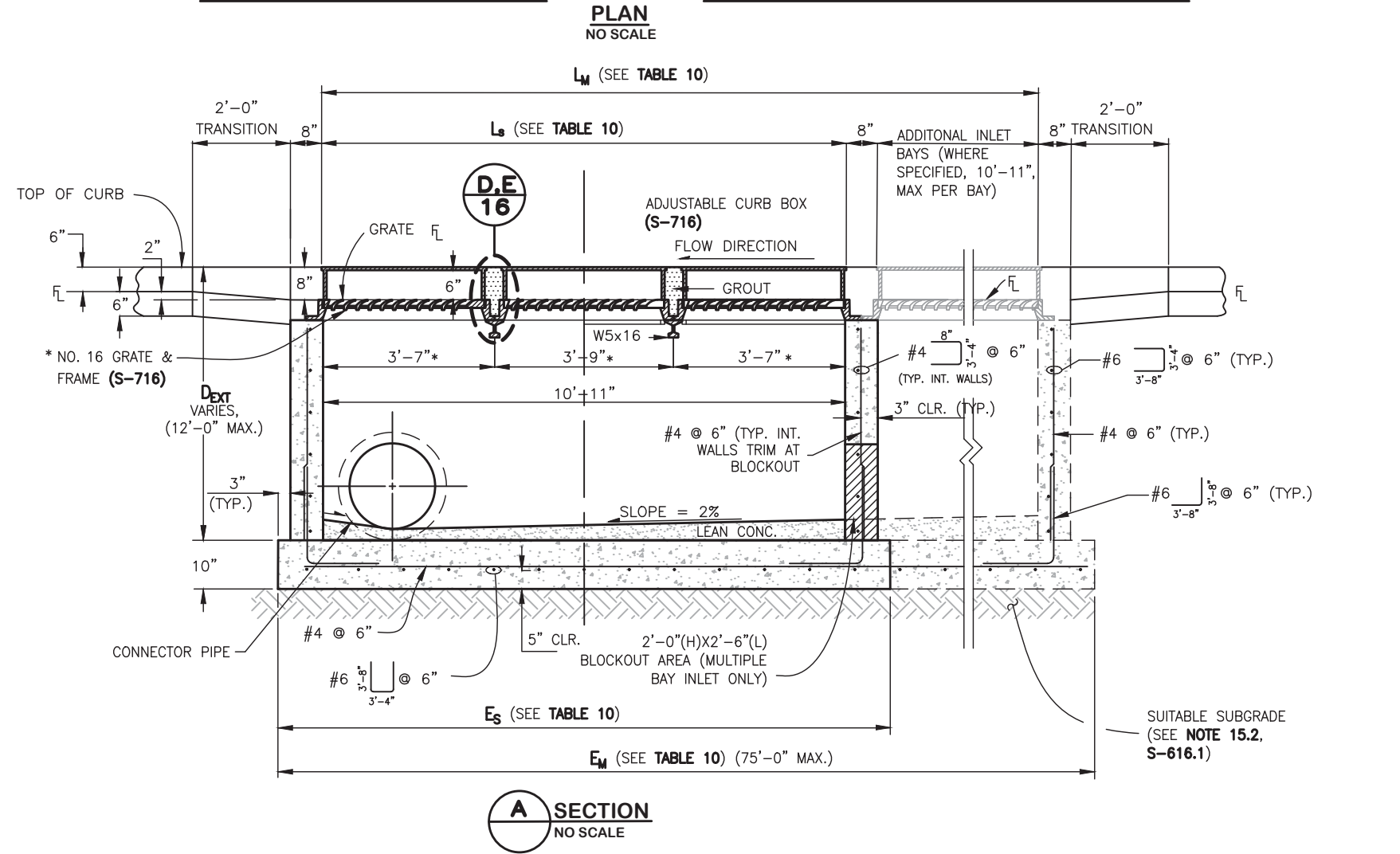
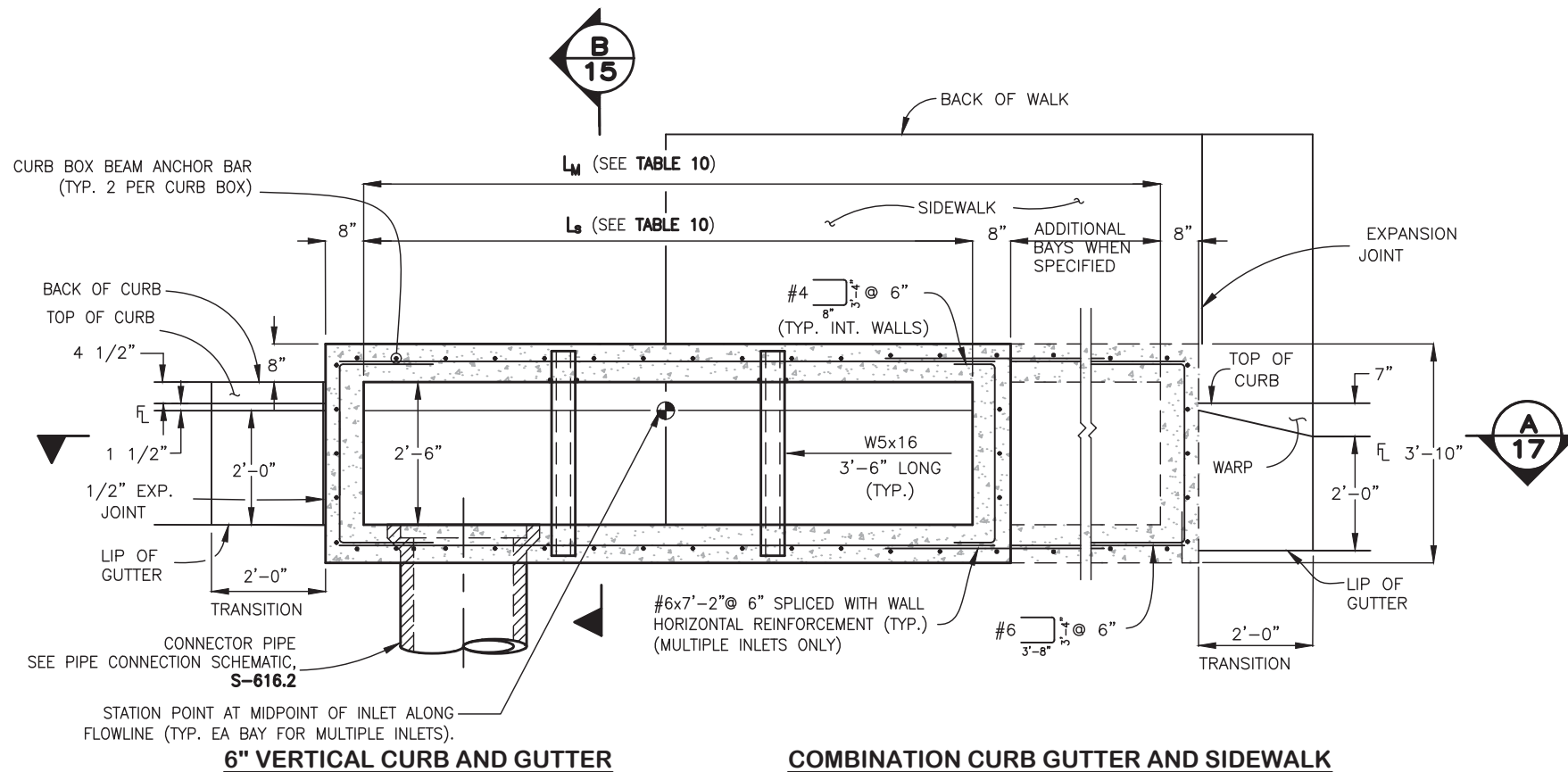
DENVER
 THE MILE HIGH CITY

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STANDARD DETAILS
DOUBLE NUMBER 16 INLET
 S-616.2

DRAWN BY:	
DESIGNED BY:	
APPROVED BY:	ASP/JDMT
DRAWING NAME:	
DATE:	JUNE 2020
SHEET NO.:	16

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TRIPLE NUMBER 16 INLET NOTES:

- 17.1 SEE WCPM STANDARD CONSTRUCTION SPECIFICATIONS SECTION 11.05 STORM INLETS FOR MORE INFORMATION. USE OF THIS DETAIL WITHOUT SPECIFICATIONS SHALL BE CONSIDERED NON-COMPLIANT.
- 17.2 SEE GENERAL NOTES ON S-616.1
- 17.3 EXPANSION JOINT MATERIAL SHALL BE PLACED FULL DEPTH OF THE CURB AND GUTTER, SIDEWALK, CONCRETE PAVEMENT, AS APPLICABLE. THE TOP PORTION OF THE JOINT SHALL BE SEALED WITH SILICONE SEALANT.
- 17.4 SEE S-616.2 FOR REBAR PLACEMENT AROUND CONNECTOR PIPE.

* STANDARD DETAIL S-716 APPLIES TO ALL OF THE GRATE & FRAME GEOMETRIC DIMENSIONS FOR THE TRIPLE NUMBER 16 INLET EXCEPT FOR THE FRAME LENGTH. FRAME LENGTH SHOULD BE MANUFACTURED FOR THE DIMENSIONS CALLED OUT ON THIS SHEET.

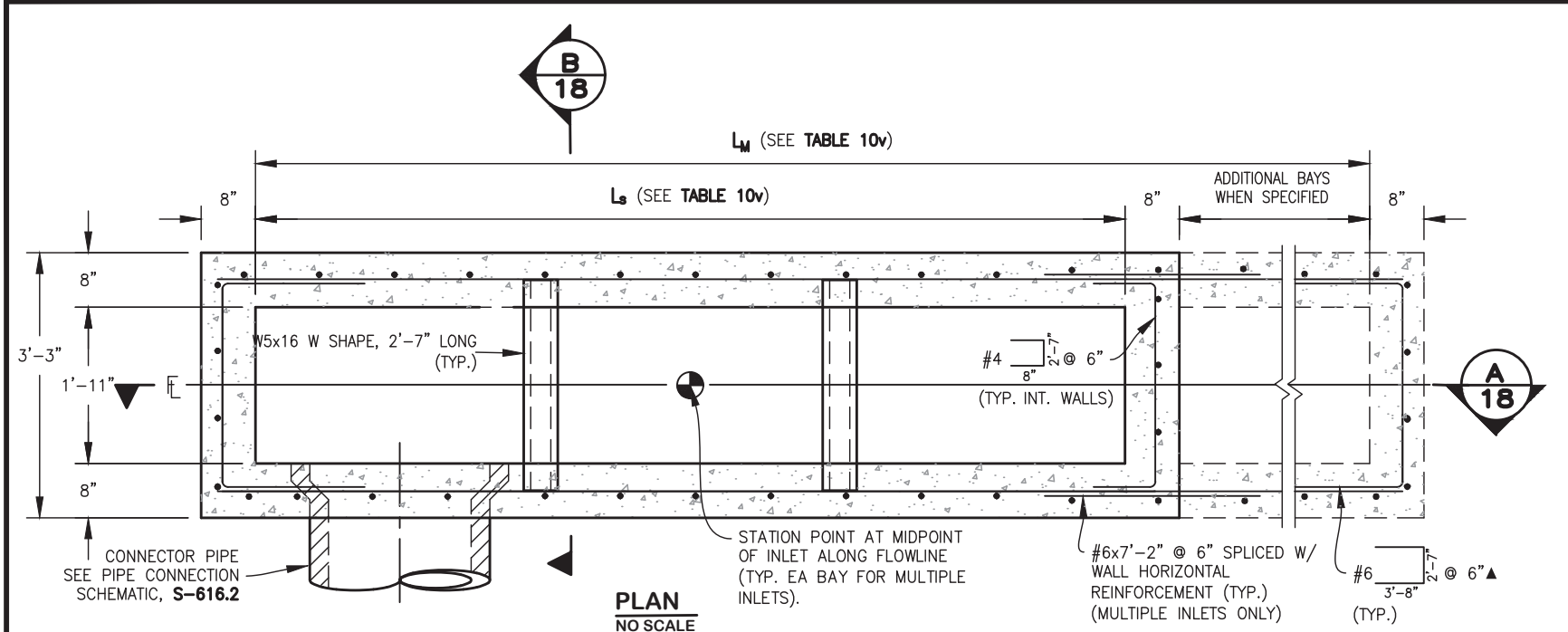
TABLE 10. NO. 16 TOTAL INLET LENGTH		
INLET CONFIGURATION	L _s OR L _M INLET LENGTH	E _s OR E _M TOTAL BOTTOM SLAB LENGTH
TRIPLE NO. 16	10'-11"	12'-9"
NO. 16 3-3-2 (EXAMPLE CONFIGURATION)	10'-11", 10'-11", 7'-1"	32'-1"
NO. 16 (CONFIGURATION TEMPLATE)	L _s , L _s , L _s	= 3" + 8" + L _s + 8" + L _s + 8" + L _s + 8" + 3"

■ MAX. BOTTOM SLAB LENGTH = 75'-0"

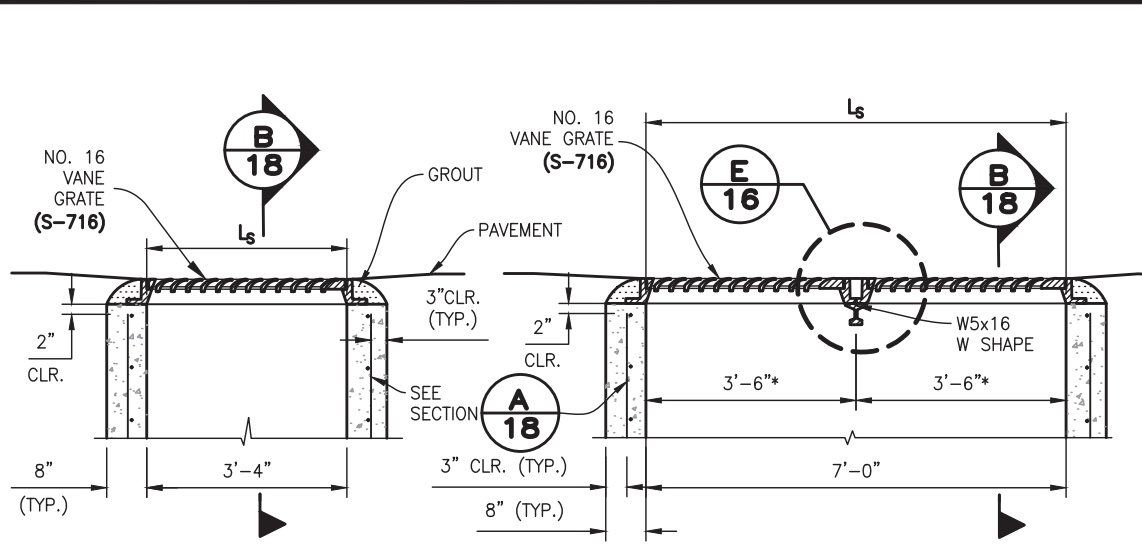
NO.	DESCRIPTION OF REVISIONS	BY
DATE		
 DENVER THE MILE HIGH CITY		
CITY AND COUNTY OF DENVER 2000 W. 3RD AVE. DENVER, CO 80223 www.denvergov.org		
STANDARD DETAILS TRIPLE NUMBER 16 INLET S-616.3		
DRAWN BY: _____		
DESIGNED BY: _____		
APPROVED BY: _____		
DRAWING NAME: _____		
DATE: _____		
JUNE 2020		
SHEET NO.: _____		
17		

PLOT DATE: May 6, 2020

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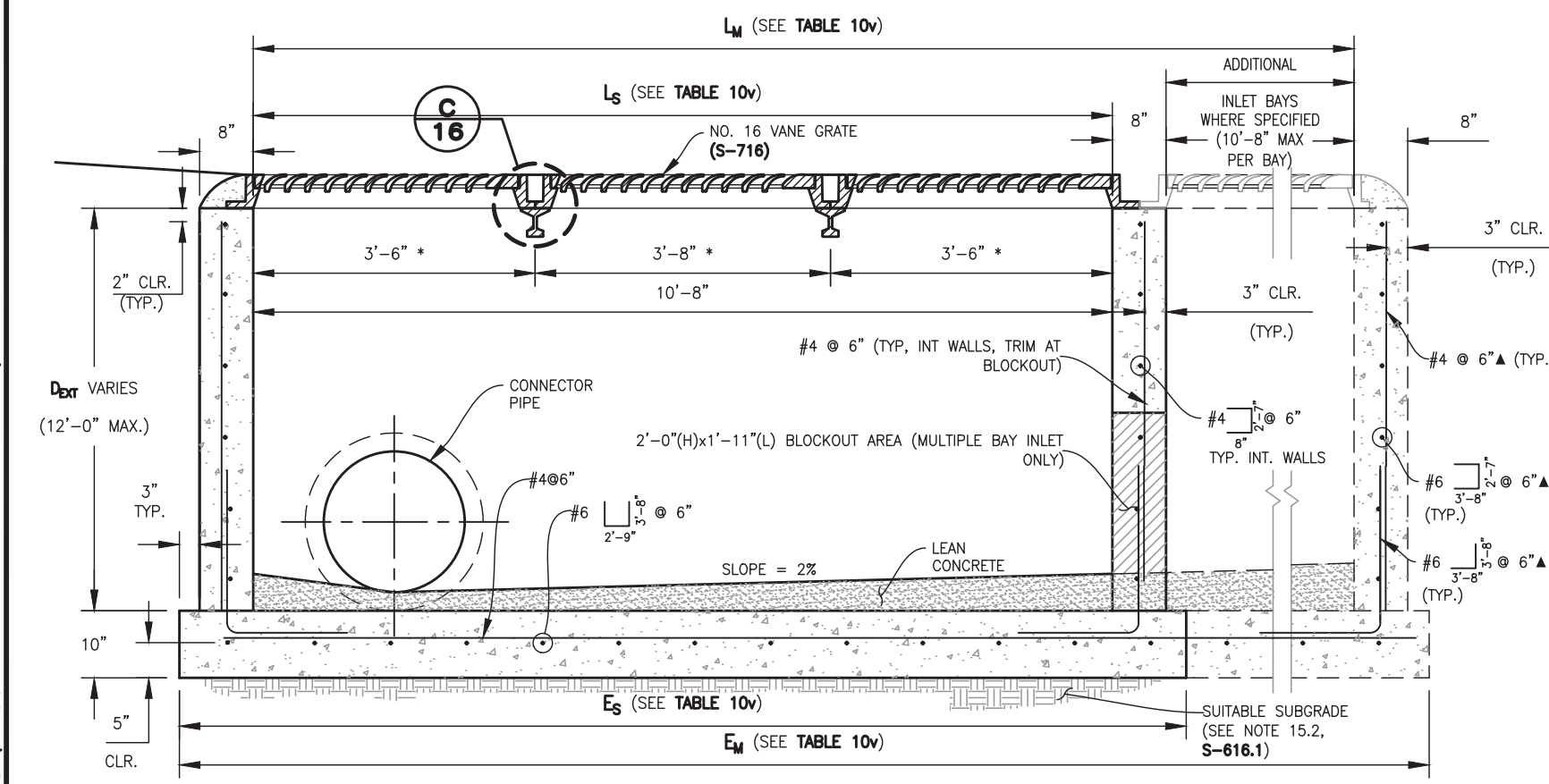


PLAN
NO SCALE

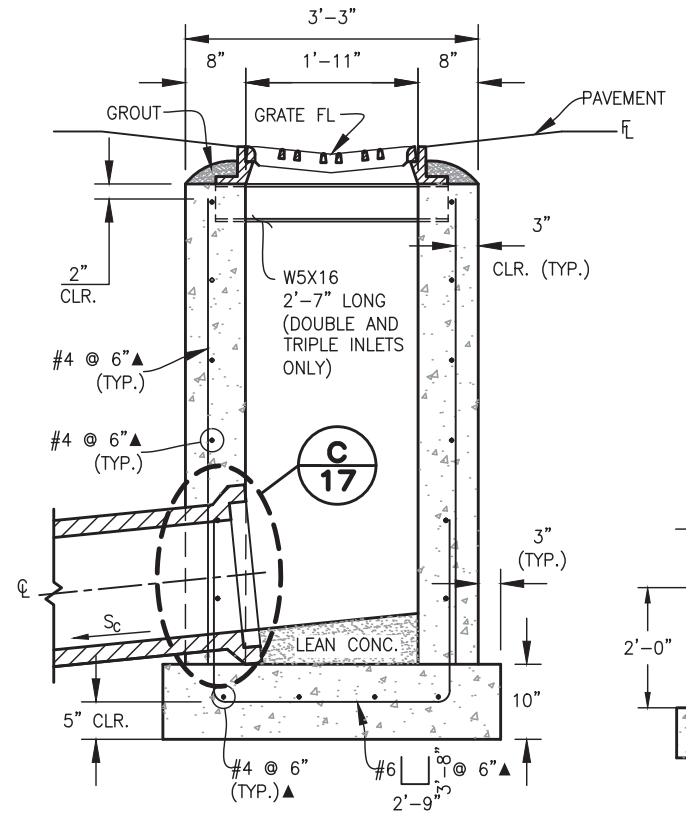


SINGLE NO. 16 VALLEY INLET
NO SCALE

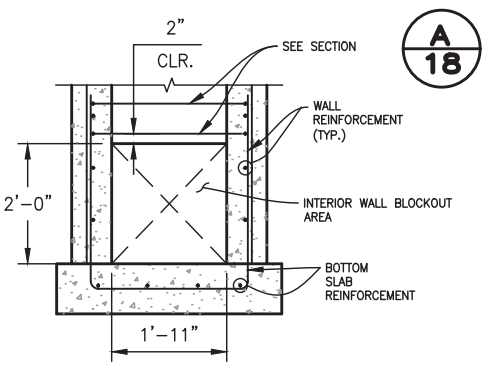
DOUBLE NO. 16 VALLEY INLET
NO SCALE



A SECTION
NO SCALE



B SECTION
NO SCALE



DETAIL-TYPICAL INTERIOR WALL BLOCK-OUT
NO SCALE

NUMBER 16 VALLEY INLET NOTES:

- 18.1 SEE WCPM STANDARD CONSTRUCTION SPECIFICATIONS SECTION 11.05 STORM INLETS FOR MORE INFORMATION. USE OF THIS DETAILS WITHOUT SPECIFICATIONS SHALL BE CONSIDERED NON-COMPLIANT.
 - 18.2 SEE GENERAL NOTES ON S-616.1
 - 18.3 SEE STANDARD DETAIL S-716 FOR FRAME AND GRATE DETAILS.
 - 18.4 SEE STANDARD DETAIL S-616.1 FOR ADDITIONAL STRUCTURE AND BACKFILL NOTES.
- * STANDARD DETAIL S-716 APPLIES TO ALL OF THE GRATE AND FRAME GEOMETRIC DIMENSIONS FOR THE NUMBER 16 VALLEY INLET EXCEPT FOR THE FRAME LENGTH, FRAME LENGTH SHOULD BE MANUFACTURED FOR THE DIMENSIONS CALLED OUT ON THIS SHEET.
- ▲ REINFORCEMENT ALSO APPLICABLE TO SINGLE AND DOUBLE NO. 16 VALLEY INLETS.

TABLE 10v. NO. 16 VALLEY TOTAL INLET LENGTH

INLET CONFIGURATION	L _S OR L _M INLET LENGTH	E _S OR E _M TOTAL BOTTOM SLAB LENGTH
TRIPLE NO. 16 VALLEY	10'-8"	12'-6"
NO. 16 VALLEY 3-3-2 (EXAMPLE CONFIGURATION)	10'-8", 10'-8", 7'-0"	31'-6"
NO. 16 VALLEY (CONFIGURATION TEMPLATE)	L _S , L _S , L _S	=3'+8"+L _S +8"+L _S +8"+L _S +8"+3"

■ MAX. BOTTOM SLAB LENGTH = 75'-0"

NO.	DESCRIPTION OF REVISIONS	DATE	BY

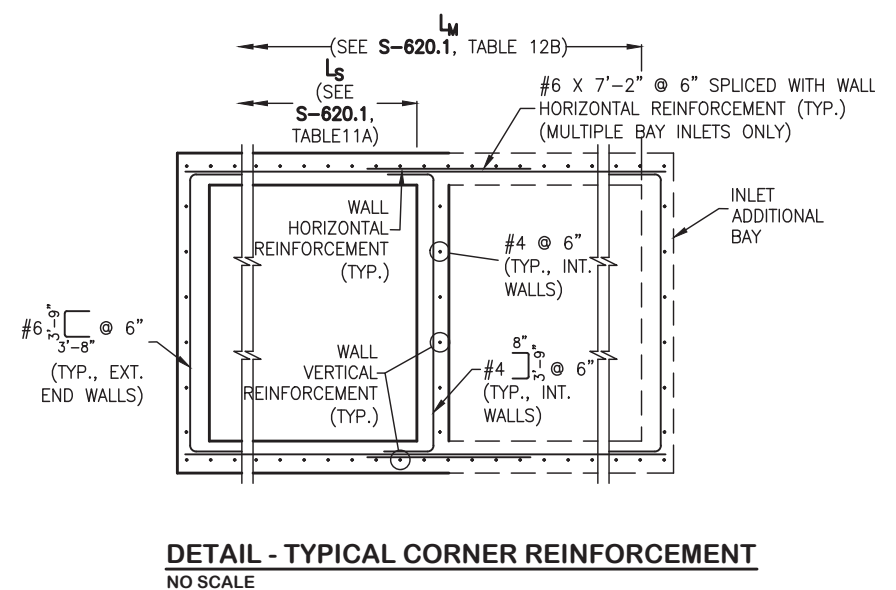
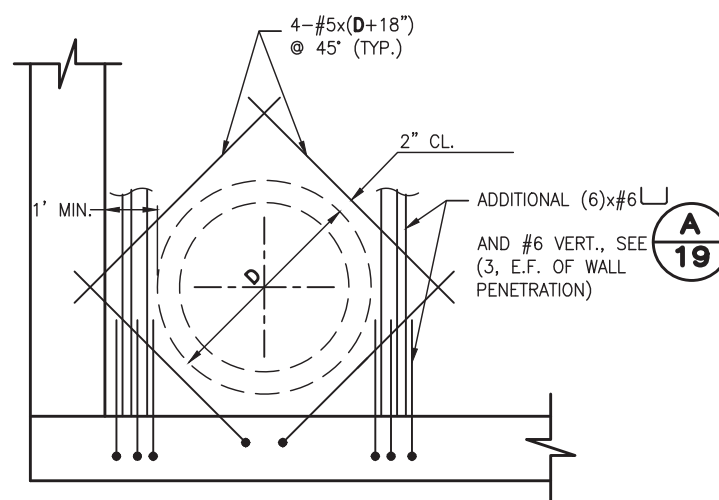
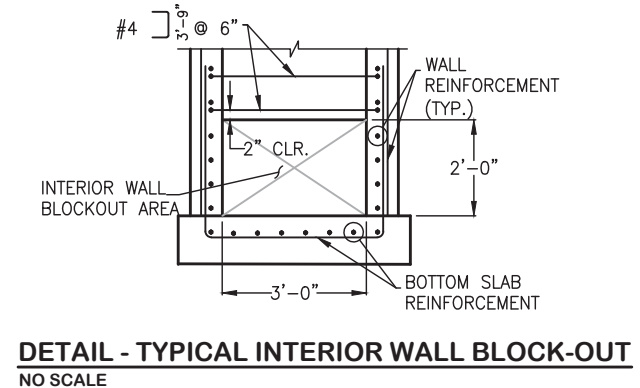
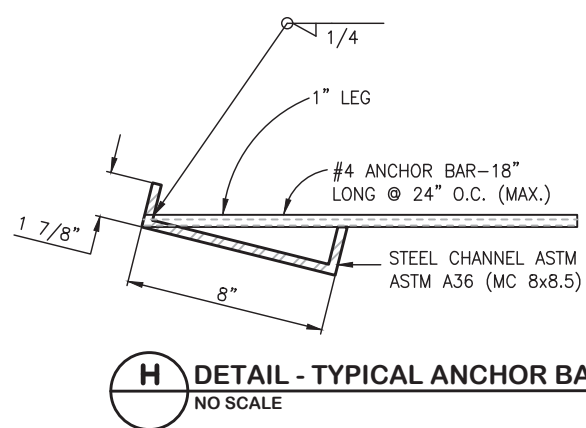
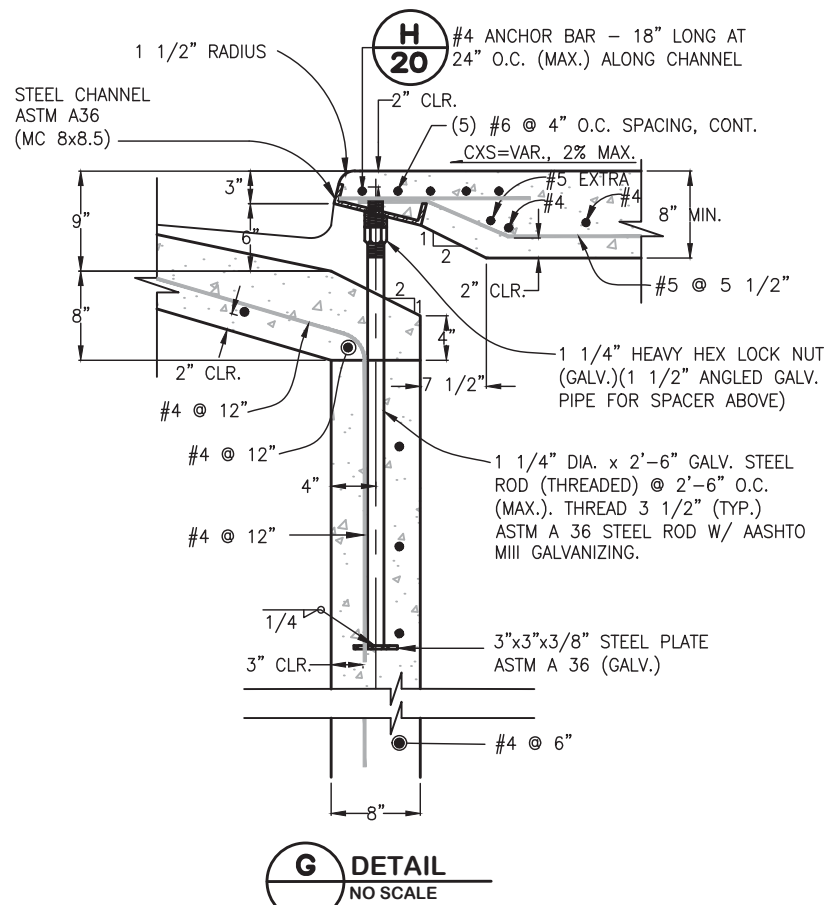
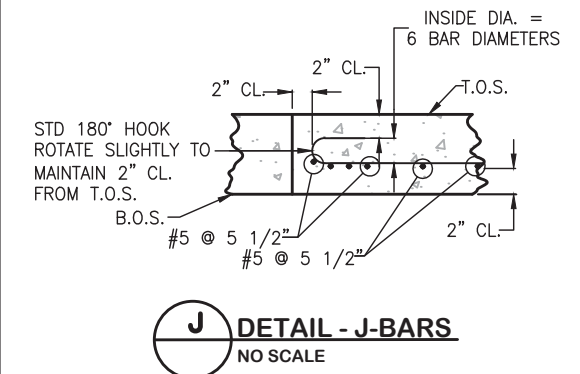
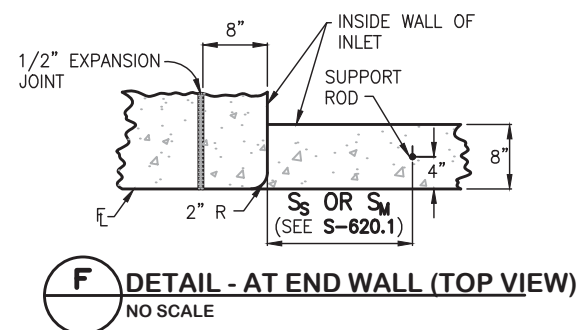
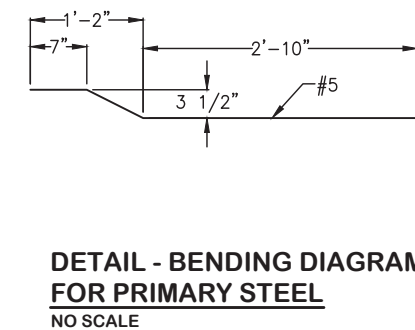
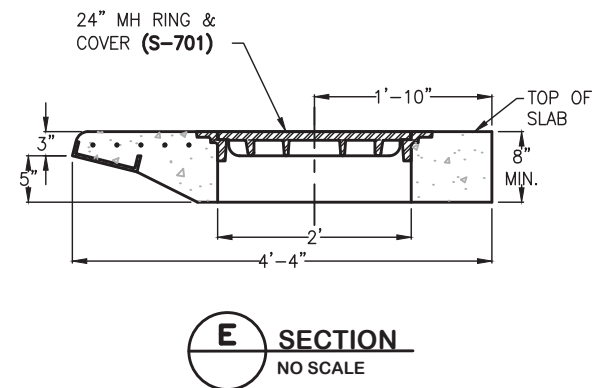
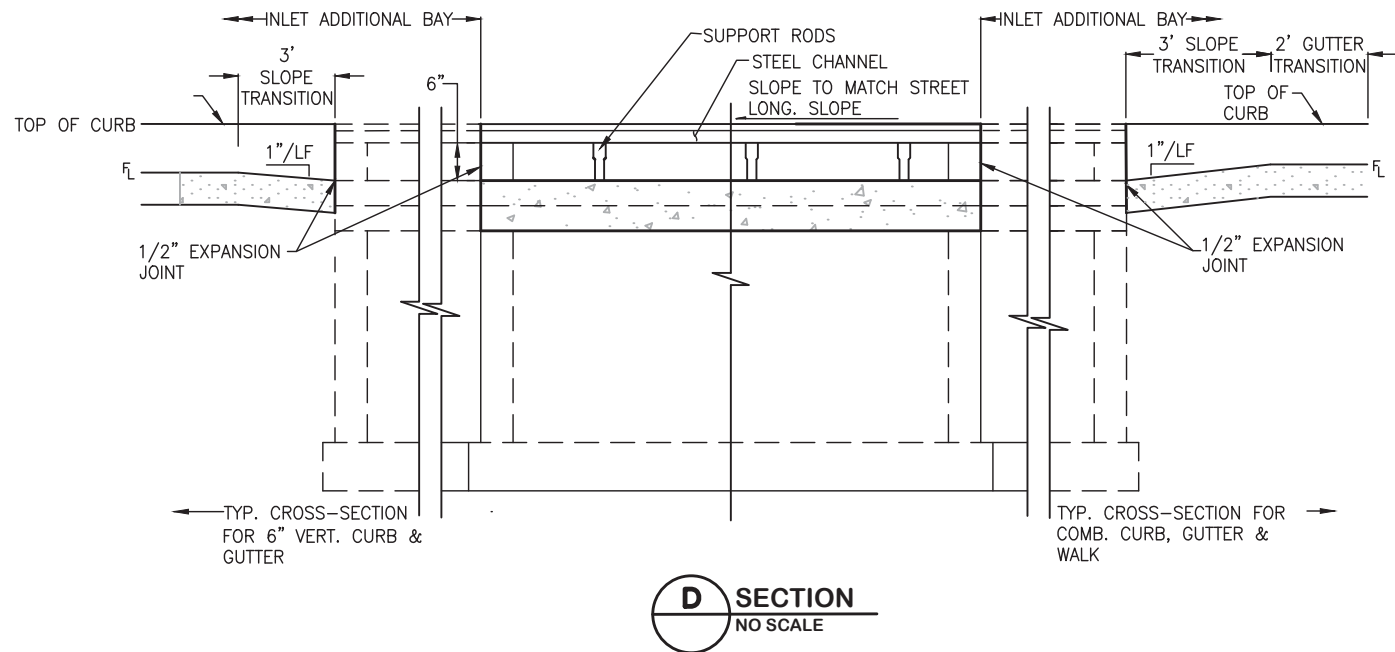


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STANDARD DETAILS
SINGLE-DOUBLE-TRIPLE
NUMBER 16 INLET VALLEY

S-616V

DRAWN BY:	APD
DESIGNED BY:	ASP/JDMT
APPROVED BY:	
DRAWING NAME:	S616-V.dwg
DATE:	JUNE 2020
SHEET NO.:	18



NUMBER 14 INLET NOTES:

- 20.1 SEE WCPM STANDARD CONSTRUCTION SPECIFICATIONS SECTION 11.05 STORM INLETS FOR MORE INFORMATION. USE OF THIS DETAIL WITHOUT SPECIFICATIONS SHALL BE CONSIDERED NON-COMPLIANT.
- 20.2 SEE GENERAL NOTES ON S-616.1 AND S-620.1.

PLOT DATE: May 4, 2020

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NO.	DESCRIPTION OF REVISIONS	DATE	BY



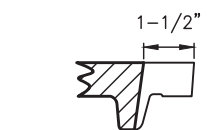
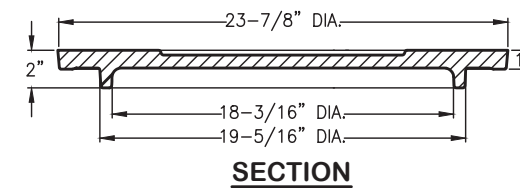
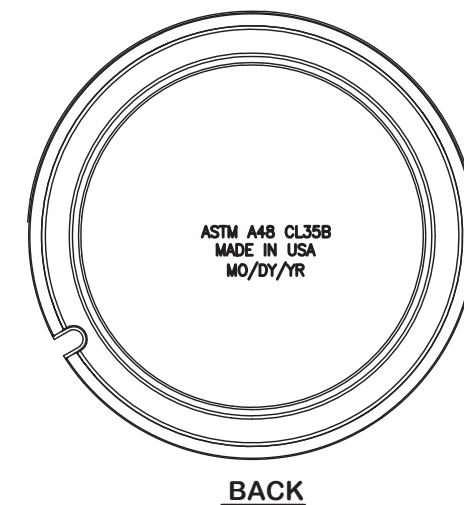
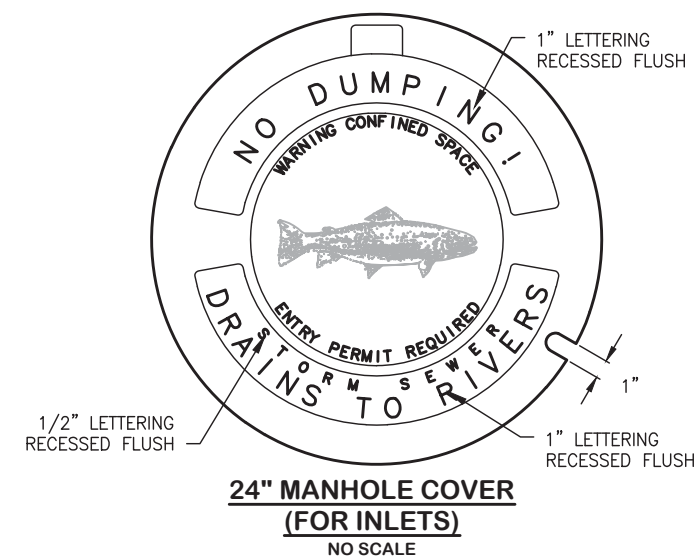
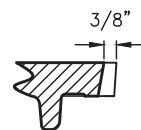
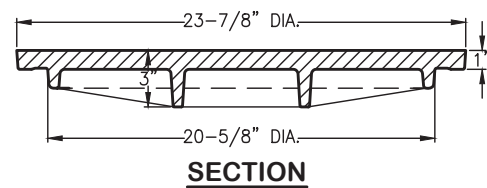
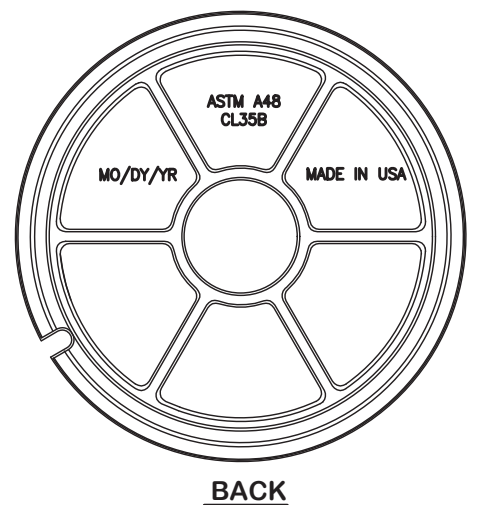
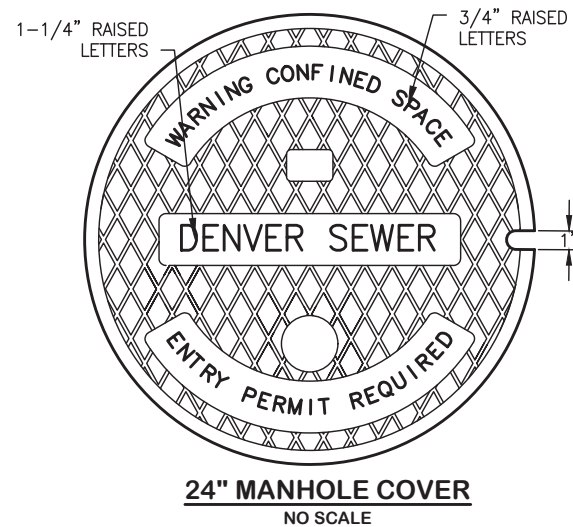
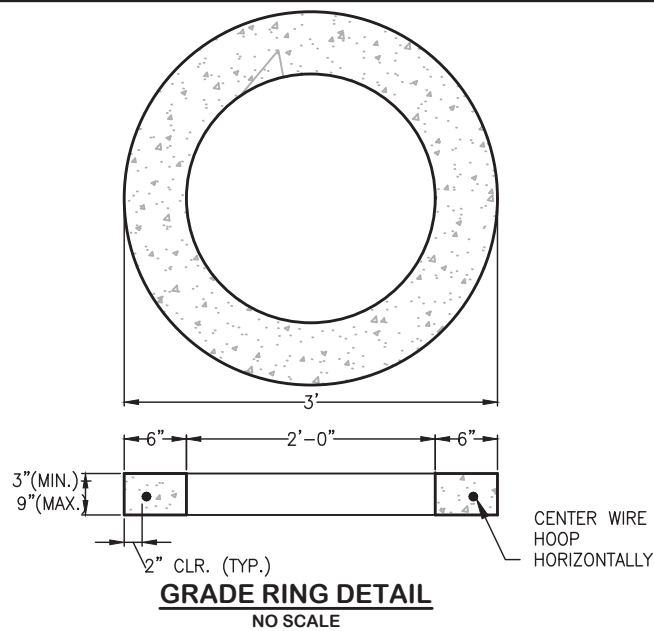
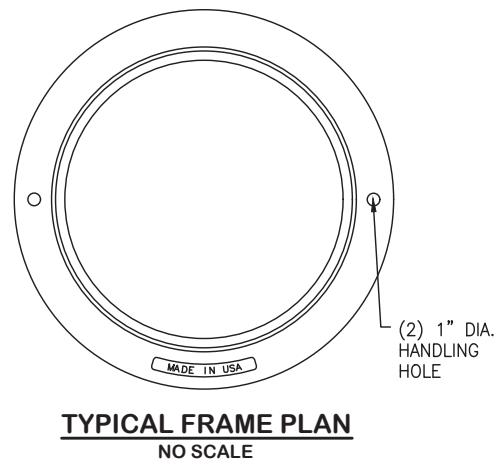
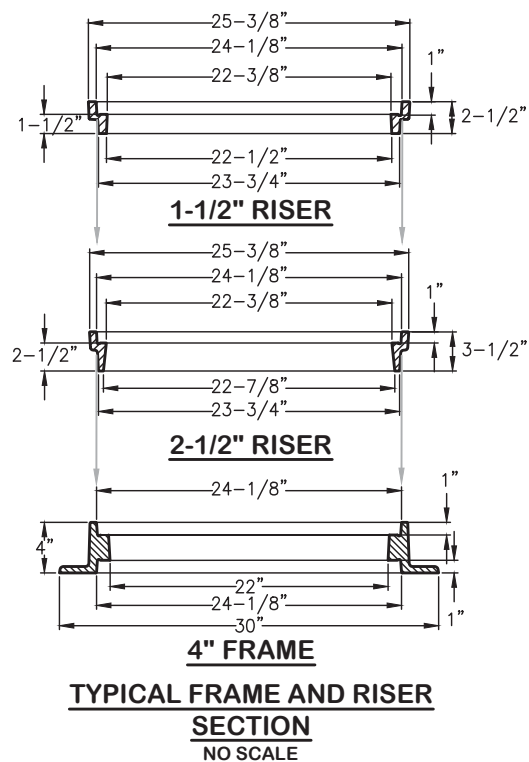
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STANDARD DETAILS
NUMBER 14 INLET
PAGE 2
S-620.2

DRAWN BY:	LJLJ
DESIGNED BY:	ASP
APPROVED BY:	
DRAWING NAME:	
DATE:	JUNE 2020
SHEET NO.:	20

PLOT DATE: May 1, 2020

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GRADE RING NOTES:

- 21.1 CONCRETE SHALL BE TYPE II CEMENT, $f_c' = 4500$ PSI, ENTRAINED AIR 5%-7% CONCRETE PER WCPM STANDARD CONSTRUCTION SPECIFICATIONS.
- 21.2 W6 WIRE HOOP SHALL BE $f_y = 65,000$ PSI PER AASHTO M32 AND ASTM A82. RING SHALL BE FULL PENETRATION-WELDED TO DEVELOP RING STRENGTH. CENTER WIRE HOOP VERTICALLY.
- 21.3 STACKED RINGS TO BE GROUTED IN PLACE. TOTAL HEIGHT OF STACKED RINGS SHALL NOT EXCEED 9".
- 21.4 RING/COVER & 2" RISER SHALL BE SET ON A FULL BED OF NON-SHRINK GROUT.
- 21.5 SET 24" MANHOLE RING 1/4" BELOW FINISH GRADE ON ALL MANHOLES. (TYPICAL FOR ALL APPLICATIONS UNLESS DETAILED OTHERWISE.)

CAST IRON LID NOTES:

- 21.6 ALL MANHOLES SHALL HAVE A 4" FRAME, 2-1/2" RISER, AND 1-1/2" RISER SET ON FULL BED OF NON-SHRINK GROUT.
- 21.7 THE CASTING SHALL BE OF GRAY CAST IRON, ASTM DESIGNATION A48 CLASS 358. THE MINIMUM TENSILE STRENGTH SHALL BE 35 KSI. THE TEST BAR DESIGNATION IS NOT DEFINED AT THIS TIME.
- 21.8 CASTINGS SHALL NOT BE DIPPED OR PAINTED, AND SHALL BE CLEAN, FREE OF FUSED SAND AND REASONABLY SMOOTH. THERE SHALL BE NO PROMINENT BLOW HOLES, NO CRACKS OR FISSURES, AND NO OBSERVED INCOMPLETE FILLING OF THE MOLD.
- 21.9 A CAST-IN-PLACE CONCRETE COLLAR IS REQUIRED IN NON-PAVED AREAS, AND OPTIONAL IN PAVED AREAS, AT THE REQUEST OF THE PROJECT ENGINEER.
- 21.10 COVERS TO DISPLAY ON VISIBLE SURFACE, A48-35 (FOR 35KSI CI), MFG'S LOGO OR NAME, YEAR (2 DIGITS), AND COUNTRY OF ORIGIN IF IMPORTED.

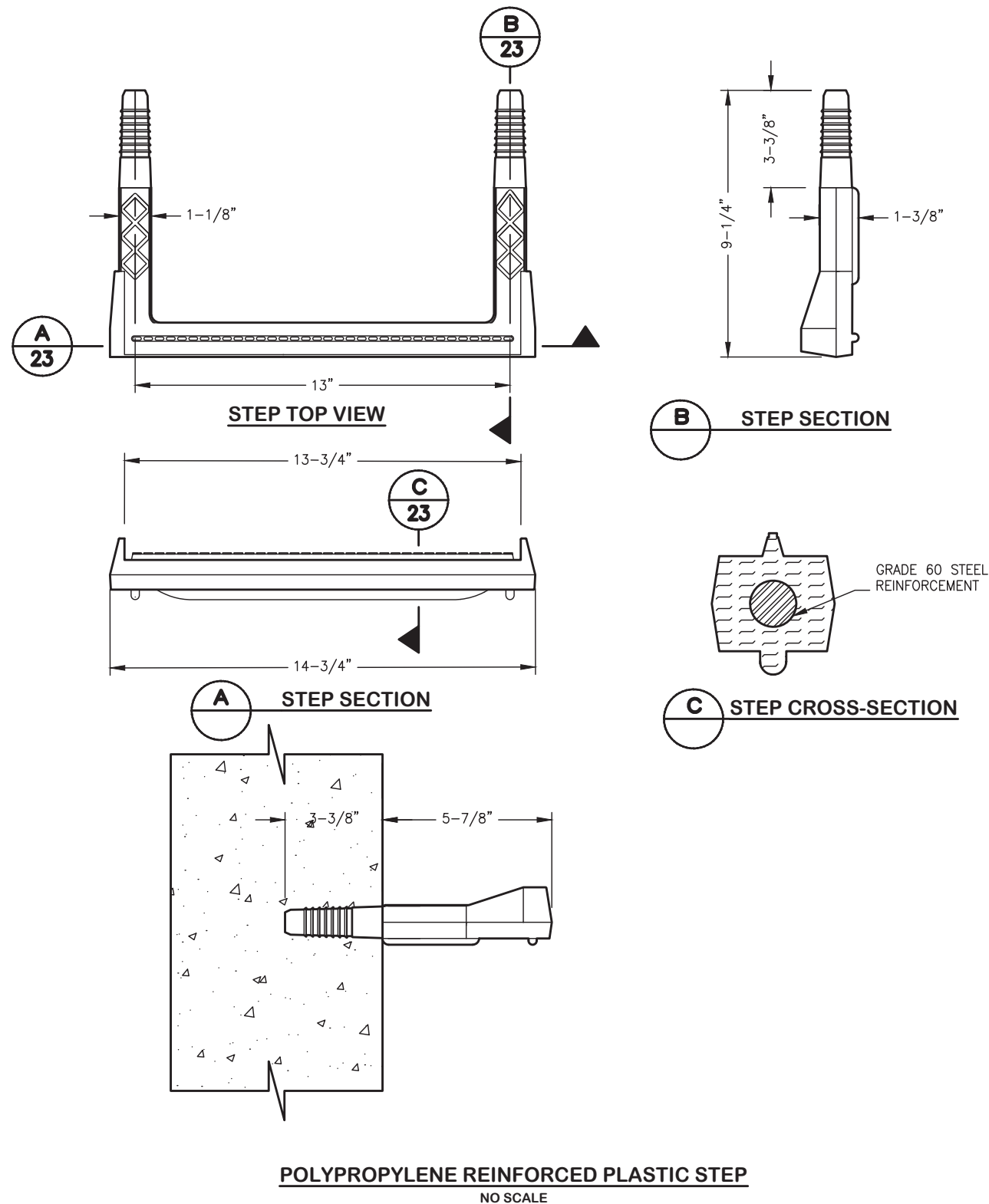
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STANDARD DETAILS
 MANHOLE GRADE RINGS, FRAME AND COVER
 S-701

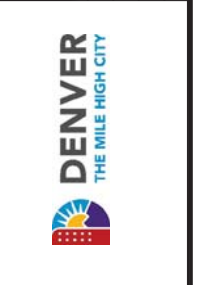
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APPROVED BY:	---
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DATE:	JUNE 2020
SHEET NO.:	21



MANHOLE STEP NOTES:

- 23.1 ASTM SPECIFICATIONS:
 - (A) ASTM C-478 (MANHOLE STEPS AND LADDERS)
 - (B) ASTM A-615 GRADE 60 (STEEL REBAR)
 - (C) ASTM 4101 (POLYPROPYLENE)
- 23.2 STEPS SHALL BE INSTALLED BY THE "PRESS-FIT" METHOD UTILIZING A SPECIALLY TAPERED PIN TO FORM THE INSERT HOLE AS SHOWN, FOLLOWING MANUFACTURER'S RECOMMENDED PROCEDURE AND SHALL NOT BE GROUTED IN PLACE.
- 23.3 INSTALLED STEPS SHALL BE CAPABLE OF WITHSTANDING A PULL OUT FORCE OF 2500 LB. PER LEG FOR A MINIMUM PERIOD OF TWO MINUTES.
- 23.4 PINS MUST BE SMOOTH AND CONTINUOUSLY TAPERED. W.M.D. INSTALLATIONS REQUIRE A MATCHED COMBINATION OF A TAPERED INSERT PIN AND MANHOLE STEP, AS RECOMMENDED OR REQUIRED BY SPECIFIC MANUFACTURER OF THE STEP TO BE USED.
- 23.5 THIS STEP CAN ALSO BE USED IN TOE POCKET INSTALLATIONS PROVIDED 5" TOE CLEARANCE IS ALLOWED. MANHOLE STEPS SHALL NOT BE INSTALLED OVER THE FLOW CHANNEL. THEY SHALL BE PLACED 12" MINIMUM OR 16" MAXIMUM IN STRAIGHT VERTICAL ALIGNMENT WITH THE BOTTOM STEP 8" ABOVE THE BENCH MINIMUM. SEE STANDARD DETAIL **S-502**.

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STANDARD DETAILS
 MANHOLE STEPS
 S-750

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