SUDAS Revision Submittal Form

Status Date:	As of 5/20/2025	**Topic:**	Determining structure diameter
Manual:	Design	**Manual Location:**	Section 2C-3, G and 3C-1, L, 10

Requested Revision:

From Section 2C-3 (Intake Design and Spacing)

…

G. Storm Sewer Structure Requirements

…

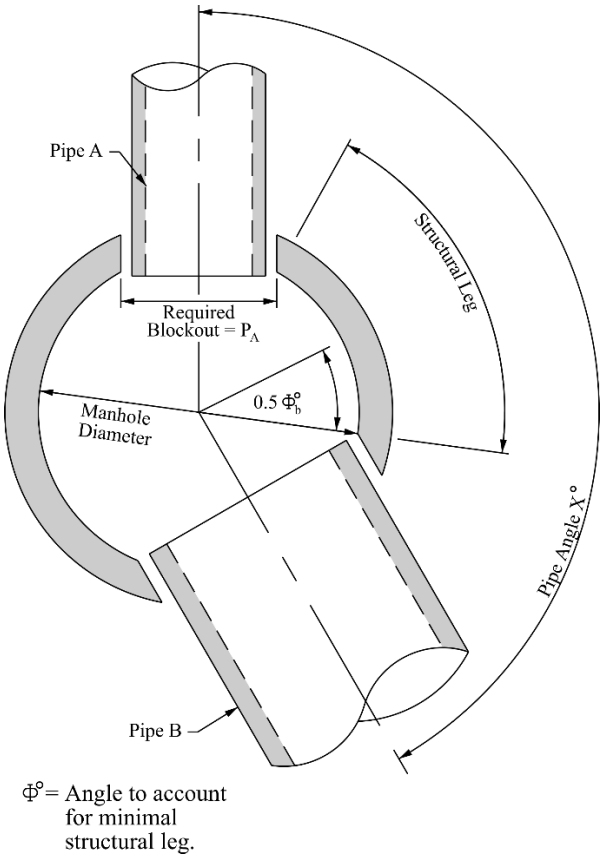
2. Openings:

…

c. Determining Diameters: When utilizing circular precast manholes, it is necessary to determine the diameter required to maintain the structural integrity of the manhole. As a general rule, a minimum ~~concrete~~ structural leg of 12 inches should remain between the manhole blockouts for adjacent pipes. Determining the required manhole diameter to provide this minimum distance may be done as follows:

1) Determine the diameters of, and the angle between, the ~~two~~ pipes in question. ~~If more than two pipes connect at the manhole, the adjacent pipes with the critical configuration (i.e. smallest angle and largest pipes) should be selected. If the critical configuration is not apparent, calculations may be required for all adjacent pipes.~~

Figure 2C-3.05: Manhole Sizing Requirements



2) Determine the blockout diameters for each opening. The blockout is the opening provided in the manhole for the pipe. Blockout dimensions are based on the outside diameter of the pipe. For storm sewer, a circular or doghouse type opening is provided with additional clearance to allow for the insertion of the pipe and sufficient space to accommodate placement of concrete grout in the opening. Typical blockout dimensions for various pipe sizes and materials are given in Table 2C-3.0~~4~~3 below.

Table 2C-3.043: Manhole Blockout Sizes

Pipe Diameter (inches)	Manhole Blockout (inches)		
	RCP	***PVC***	***DIP***
12	21	16	16
14	N/A	16	18
15	24	19	N/A
16	N/A	N/A	20
18	28	22	23
20	N/A	N/A	24
21	31	25	N/A
24	35	28	29
27	38	31	N/A
30	42	35	36
33	47	N/A	N/A
36	48	42	41
42	57	N/A	N/A
48	64	N/A	N/A
54	71	N/A	N/A
60	78	N/A	N/A

~~3) Determine the diameter of the manhole required to provide the minimum concrete leg dimension. This diameter may be calculated with the following equation:~~

$$MH_d = \frac{BO_1 + BO_2 + 2CL}{\theta \times \left(\pi/180\right)}$$ ~~**Equation 2C-3.19**~~

~~where:~~

~~MH_d = Manhole diameter, in~~
~~BO = Blockout diameter, in~~
~~CL = Minimum concrete leg length, in (typically 12 inches)~~
~~θ = Angle between pipe centerlines, degrees~~

~~4) Round the minimum manhole diameter calculated, up to the next standard manhole size (48 inches, 60 inches, 72 inches, 84 inches, 96 inches, 108 inches, or 120 inches).~~
~~5) Verify that the manhole diameter calculated is sufficient for the largest pipe diameter (See Table 2C-3.04).~~

3) Select a manhole size. If unsure start with the diameter for the largest penetration from Table 2C-3.04.

Table 2C-3.04: Minimum Manhole Diameter Required for Pipe Size

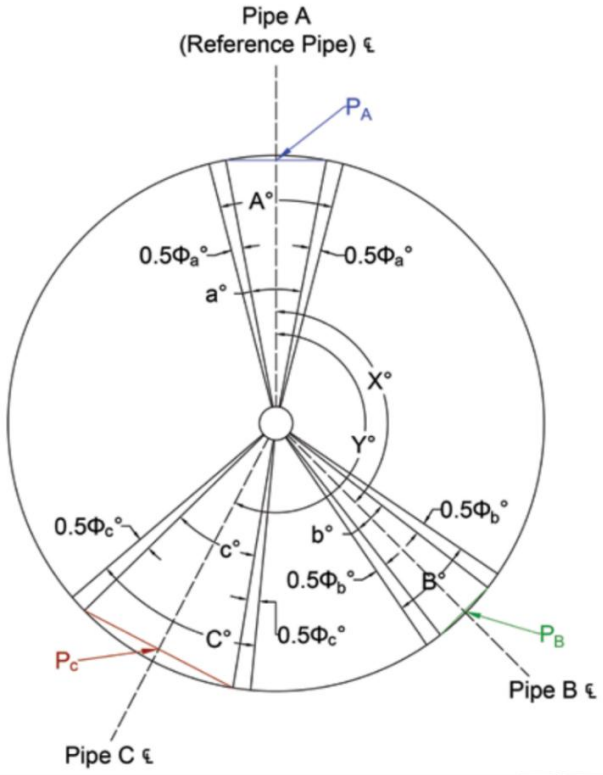
Pipe Diameter (inches)	Minimum Manhole Diameter (inches)		
	RCP	***PVC***	***DIP***
8	N/A	48	48
10	N/A	48	48
12	48	48	48
14	N/A	N/A	48
15	48	48	N/A
16	N/A	N/A	48
18	48	48	48
20	N/A	N/A	48
21	48	48	N/A
24	48	48	48
27	*60	48	N/A
30	*60	*60	*60
33	*60	N/A	N/A

36	*60	*60	*60
42	*72		
48	*84		
54	*96		
60	*96		

*48 inch diameter Tee-section manhole may be used for pipes 27 inches and greater.

The determination of acceptability of each entering pipe relative to all the other incoming pipe is based on the reference pipe, which is arbitrarily selected by the designer. For ease of design, it is best to use the largest pipe diameter as the reference pipe. The other incoming pipe are determined by their angle, X, Y, and Z (not shown in the figure below), to this reference pipe. The figure below and corresponding equations are used for making these verifiable calculations:

Figure 2C-3.06: Three Pipe Configuration



Variables:

r	=	manhole internal radius (in inches)
S	=	minimum structural leg (in inches) (recommended 12 inches)
P_A, P_B, P_C, P_D	=	penetration in manhole to accommodate specified pipe (inches)

Pipe Penetration Equation:

P_A, P_B, P_C, P_D = pipe OD (in inches) + additional allowance for insertion (if unsure use 6 inches)

Table 2C-3.05: Design Parameters for Two Pipes

Pipe Penetrations in Manhole	Pipe Angle with Respect to Reference Point	Pipe Angle Equations		Final Angle	Allowable Angle Range
		Initial Angle	Additional Angle to Account for Structural Leg		
Pipe A (Reference Pipe)	0°	$a^{\circ} = 2\ x\ sin^{-1}\left(\frac{0.5\ x\ P_A}{r}\right)$	$\Phi_a° = \frac{S\ x\ 180°}{\pi\ x\ r}$	$A^{\circ} = a^{\circ} + \Phi_a°$	$A° < 180°$
Pipe B	$X°$	$b° = 2\ x\ sin^{-1}\left(\frac{0.5\ x\ P_B}{r}\right)$	$\Phi_b° = \frac{S\ x\ 180°}{\pi\ x\ r}$	$B° = b° + \Phi_b°$	$X° - \frac{B°}{2} > \frac{A°}{2}$

Table 2C-3.06: Design Parameters for Three Pipes

Pipe Penetrations in Manhole	Pipe Angle with Respect to Reference Point	Pipe Angle Equations		Final Angle	Allowable Angle Range
		Initial Angle	Additional Angle to Account for Structural Leg		
Pipe A (Reference Pipe)	0°	$a^{\circ} = 2\ x\ sin^{-1}\left(\frac{0.5\ x\ P_A}{r}\right)$	$\Phi_a° = \frac{S\ x\ 180°}{\pi\ x\ r}$	$A^{\circ} = a^{\circ} + \Phi_a°$	$A° < 180°$
Pipe B	$X°$	$b° = 2\ x\ sin^{-1}\left(\frac{0.5\ x\ P_B}{r}\right)$	$\Phi_b° = \frac{S\ x\ 180°}{\pi\ x\ r}$	$B° = b° + \Phi_b°$	$X° - \frac{B°}{2} > \frac{A°}{2}$
Pipe C	$Y°$	$c° = 2\ x\ sin^{-1}\left(\frac{0.5\ x\ P_C}{r}\right)$	$\Phi_c° = \frac{S\ x\ 180°}{\pi\ x\ r}$	$C° = c° + \Phi_c°$	$Y° - \frac{C°}{2} > X° + \frac{B°}{2}$ and $Y° + \frac{C°}{2} < 360° - \frac{A°}{2}$

Table 2C-3.07: Design Parameters for Four Pipes

Pipe Penetrations in Manhole	Pipe Angle with Respect to Reference Point	Pipe Angle Equations		Final Angle	Allowable Angle Range
		Initial Angle	Additional Angle to Account for Structural Leg		
Pipe A (Reference Pipe)	0°	$a^{\circ} = 2\ x\ sin^{-1}\left(\frac{0.5\ x\ P_A}{r}\right)$	$\Phi_a° = \frac{S\ x\ 180°}{\pi\ x\ r}$	$A^{\circ} = a^{\circ} + \Phi_a°$	$A° < 180°$
Pipe B	$X°$	$b° = 2\ x\ sin^{-1}\left(\frac{0.5\ x\ P_B}{r}\right)$	$\Phi_b° = \frac{S\ x\ 180°}{\pi\ x\ r}$	$B° = b° + \Phi_b°$	$X° - \frac{B°}{2} > \frac{A°}{2}$
Pipe C	$Y°$	$c° = 2\ x\ sin^{-1}\left(\frac{0.5\ x\ P_C}{r}\right)$	$\Phi_c° = \frac{S\ x\ 180°}{\pi\ x\ r}$	$C° = c° + \Phi_c°$	$Y° - \frac{C°}{2} > X° + \frac{B°}{2}$
Pipe D	$Z°$	$d° = 2\ x\ sin^{-1}\left(\frac{0.5\ x\ P_D}{r}\right)$	$\Phi_d° = \frac{S\ x\ 180°}{\pi\ x\ r}$	$D° = d° + \Phi_d°$	$Z° - \frac{D°}{2} > Y° + \frac{C°}{2}$ and $Z° + \frac{D°}{2} < 360° - \frac{A°}{2}$

NOTE: Pipe D is not displayed on Figure 2C-3.05, but it would follow the same convention as Pipe A, Pipe B, and Pipe C as displayed on the diagram.

From Section 3C-1 [(Sanitary Sewer) Facility Design], L (Manhole)

10. **Manhole Sizes:** ~~When utilizing circular precast manholes, it is necessary to determine the diameter required to maintain the structural integrity of the manhole. As a general rule, a minimum concrete leg of 6 inches should remain between the manhole blockouts for adjacent pipes. Determining the required manhole diameter to provide this minimum distance may be done as follows:…~~(*more language follows; delete all)* See Section 2C-3, G, 2, c.

Reason for Revision:	This came up while researching a question regarding conflicting size requirements for minimum concrete leg between openings.		
Comments:	None.		
Region:	☒ Central	☐ East	☐ West
Comments:	Include both figures, but fix the old one. Change “concrete” leg to “structural” leg. *Note - done.*		
Action:	☐ Deferred	☐ Not Approved	☒ Approved
Region:	☐ Central	☒ East	☐ West
Comments:	None.		
Action:	☐ Deferred	☐ Not Approved	☒ Approved
Region:	☐ Central	☐ East	☒ West
Comments:	None.		
Action:	☐ Deferred	☐ Not Approved	☒ Approved

Final Regional Action Summary: All 3 regions approved; see comments above.

Board of Directors Action: Approved.