

# **CITY UTILITIES DESIGN STANDARDS MANUAL**

**Book 3  
Sanitary (SA)  
SA7 Manhole Design**

June 2015

### SA7.01 Purpose

This Chapter establishes the minimum standards and technical design criteria for City of Fort Wayne sanitary sewer system manholes. Variances from these design standards must be approved in compliance with [Chapter GR3-Variances](#).

1. This Chapter covers the following topics:
  - Location of Manholes and Manhole Spacing
  - Manhole Dimensions
  - Manhole and Cleanout Castings
  - Standard Manholes
  - Flow Channel and U-Shaped Bench
  - Protection Against Ponding and Potential I/I
  - Watertight Bolt Down Construction
  - Buoyancy
  - Connections
  - Casting Adjustments
2. The following topics are covered in other Chapters:
  - Gravity Sanitary Sewers ([Chapter SA5- Sewer Design](#))
  - Metering Structures and Separators ([Chapter SA6- Building Sewer and Appurtenance Design](#))
  - Wet Wells and Valve Vaults ([Chapter SA8 – Lift Station and Force Main Design](#))

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### SA7.02 Manholes

1. General
  - Building sewers shall not be connected at manholes if avoidable. See [Chapter SA6- Building Sewer and Appurtenance Design](#) for further information.
  - Cleanouts shall not be used in lieu of manholes on publically owned, operated and maintained systems, and
  - Manholes shall be cast-in-place or pre-cast concrete.
2. Location

Manholes shall be placed at the following locations:

  - End of each sewer segment
  - Changes in sewer slopes, size, alignments or pipe material
  - Sewer junctions
  - Where spacing requirements justify placement

3. Manhole Spacing

Figure SA7.1 provides requirements for maximum spacing between manhole structures.

**Figure SA7.1 Manhole Spacing**

Pipe Diameter	Maximum Distance Between Manholes
8" to 15"	400'
18" to 30"	500'
33" and greater	600'

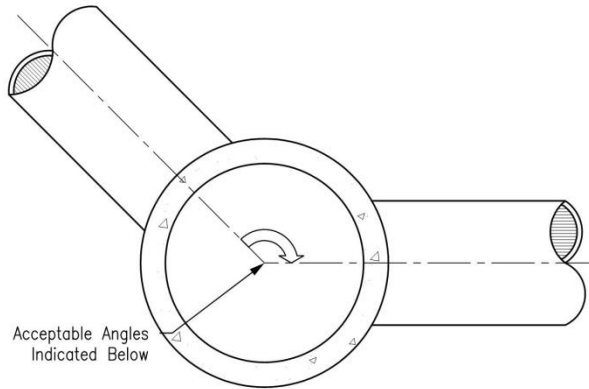
4. Manhole Dimensions

Change in flow direction (internal angles between pipes) at manhole junctions of less than 90 degrees (90°) are not allowed due to hydraulic losses.

A minimum access diameter of 24-inches shall be provided. All manholes must have sufficient wall space between pipe openings to meet the following criteria:

For circular structures, the minimum distance allowed between pre-cast holes shall be six-inches.

The following Figures present general criteria for the maximum pipe size that can connect to a specific diameter manhole structure. These Figures are for guidance as existing conditions may dictate variance.



**Figure SA7.2 PIPE CONNECTIONS LESS THAN 30-INCH DIAMETER**

Applicable Pipe Materials and Sizes				Opening Required (in)	Acceptable Angles (deg) for the Following Manhole sizes:		
RCP	HDPE	DI	PVC		48 in	60 in	72 in
ASTM C 76	ASTM F714	AWWA C151	ASTM F679				
12" Wall B	16"	14"	15" ASTM D3034	18	180-90		
12" Wall C	18"	16"		20	180-90		
15" Wall B	20"	18"	18"	22	180-90		
15" Wall C	22"	20"	21"	24	180-90		
18" Wall B&C	24"			26	180-90		
21" Wall B		24"	24"	28	180-100	99-90	
21" Wall C			27"	30		180-90	
24" Wall B				32		180-90	
24" Wall C				34		180-90	
27" Wall B				36			180-90
27" Wall C				38			180-90

- NOTES:
1. Pipe angles less than 90° not allowed.
  2. This table is a guide. Existing conditions may dictate variance.
  3. Square or rectangular structures should be considered in place of 96" and 108" diameter manhole structures.
  4. Contact manhole supplier for size verification for diameters smaller than indicated in table.
  5. Wall B and Wall C are ASTM designations for pipe wall thickness where Wall C is thicker by approximately 3/4 of an inch.

Figure SA7.3 PIPE CONNECTIONS 30-INCH DIAMETER AND GREATER

Applicable Pipe Materials and Sizes		Opening Required (in)	Acceptable Angles (deg) for the following Manhole sizes:				Larger
RCP ASTM C 76	PVC ASTM F679		72 in	84 in	96 in	108 in	
	30"	38	180-90				
	36"	44	180-90				
30" Wall B		45	180-90				
30" Wall C		46.5	180-100	99-90			
33" Wall B		48.5	180-104	103-90			
33" Wall C		50	180-107	106-90			
36" Wall B		52	180-112	111-90			
36" Wall C		53.5	180-115	114-96	95-90		
42" Wall B		59	180-130	129-106	105-90		
42" Wall C		60.5	180-134	133-109	108-90		
48" Wall B		66	180-152	151-120	119-100	99-90	
48" Wall C		67.5	180-158	157-124	123-104	103-90	
54" Wall B		73		180-137	136-114	113-98	CONTACT MFR
54" Wall C		74.5		180-142	141-116	115-100	
60" Wall B		80		180-161	160-129	127-108	
60" Wall C		81.5		180-169	168-130	129-110	
66" Wall B		87			180-145	144-120	
66" Wall C		88.5			180-140	139-123	

- NOTES:
1. Pipe angles less than 90° not allowed.
  2. This table is a guide. Existing conditions may dictate variance.
  3. Square or rectangular structures should be considered in place of 96" and 108" diameter manhole structures.
  4. Contact manhole supplier for size verification for diameters smaller than indicated in table.
  5. Wall B and Wall C are ASTM designations for pipe wall thickness where Wall C is thicker by approximately 3/4 of an inch.

5. Manhole Castings

Refer to Standard Drawing [C-1-1](#) for 24-inch sanitary manhole casting details.

Refer Standard Drawings [C-2-1](#) and [C-2-2](#) for watertight sanitary manhole casting details.

6. Cleanout Castings

Refer to Standard Drawings [C-3-1](#) and [C-3-2](#) for standard cleanout casting details.

7. Standard Manholes

Refer to the following Standard Drawings:

- [STR-20-1](#) Standard 48-inch Manhole
- [STR-20-2](#) Standard 60-inch Manhole
- [STR-20-3](#) Standard 72-inch Manhole
- [STR-20-4](#) Standard 84-inch to 96-inch Manhole
- [STR-12-1](#) Cast in Place Base 48-inch and Less
- [STR-12-2](#) Cast in Place Base 54-inch to 96-inch

A doghouse manhole may be used when placing a new manhole over an existing sewer main line.

8. Flow Channel

For all manholes with equal diameter influent and effluent pipes, a minimum 0.10 foot drop between the inverts of the influent and effluent pipes shall be maintained to offset losses experienced at manhole structures. For change in direction 45 degrees to 90 degrees, a minimum 0.20 foot drop shall be maintained.

The flow channel through a manhole shall be made to conform in shape, and slope to that of connecting sewers. The channel walls shall be shaped or formed to the full height of the crown of the outlet sewer so that maintenance, inspection, and flow in the manhole are not obstructed.

Refer to Standard Drawings [STR-13-1](#) and [STR-13-2](#) for details of manhole flow channel shapes.

9. U-Shaped Bench

A bench shall be provided on each side of any manhole channel when the pipe diameter(s) are less than the manhole diameter. The bench shall be sloped no less than ½ -inch per foot (4.17 percent slope).

10. Protection Against Ponding and Inflow/Infiltration

To provide protection against ponding, manholes shall be designed and constructed to provide positive drainage away from the top of casting as follows:

- Paved or stone areas – Top of casting shall be flush with finished grade.
- Unpaved areas – Top of casting shall be a minimum of 3-inches above finished grade.

To minimize the potential for extraneous clear water known as inflow/infiltration (I/I) entering the sewer system, manholes shall not be designed or installed in any drainage path such as, but not limited to, the following locations:

- Swales or ditches
- Roadside gutters
- Inverted crowns of streets
- Low points of paved or unpaved areas
- Adjacent to stormwater inlets

11. Watertight Bolt-Down Construction

Watertight manholes and covers shall be used in all areas where flooding by street runoff or anticipated high water levels are expected, in a floodway or floodplain. (Title 327 IAC 3-6-16)

12. Buoyancy

Buoyancy shall be analyzed on the manhole structure to determine whether additional methods of restraint are necessary. Mechanical equipment, water weight, and other temporary loads shall not be included in the analysis.

Buoyancy force, opposing force and factor of safety shall be computed as follows:

$$\text{Buoyancy Force} = (\text{Displaced Volume}) \times (\text{Unit Weight of Water})$$

Opposing Force = Weight of Barrels + Weight of Bottom Slab + Weight of Top Slab + Net Weight of Saturated Soil Over Bottom Slab Extension + Any Additional Constraints (excluding electrical and mechanical components). The unit weight of water is 62.4 lbs/cu.ft.

$$\text{Factor of Safety} = \frac{\text{Opposing Force}}{\text{Buoyant Force}} > 1.25$$

If the factor of safety is not greater than 1.25, restraint measures shall be employed. City Utilities Engineering shall be consulted in these instances.

13. Connections

For pipe connections to manhole refer to Standard Drawing [STR-14-1](#) for pipes 36-inches in diameter and smaller, and to Standard Drawing [STR-14-2](#) for pipes larger than 36-inches in diameter.

A. External Drop

- An external vertical drop shall be provided for any pipe invert entering a manhole at an elevation greater than 2- feet above the pipe invert through the manhole.
- The drop shall be concrete encased.
- Refer to Standard Drawing [STR-15-1](#).

B. Internal Drop

- An internal vertical drop may be used for connection to an existing manhole that would require a deep excavation to enter the manhole to within 2-feet above the pipe invert through the manhole.
- See Standard Drawing [STR-15-2](#) Inside Drop Connection for detail of gravity sewer internal drop into existing manhole and Standard Drawing [STR-22-1](#) Typical Drop Connection for Low Pressure Pumping System for detail of force main internal drop into existing manhole.

14. Casting Adjustment

- In general, acceptable riser ring sizes are 3, 4, and 6-inches. Refer to Standard Drawing [STR-23-1](#) for the sanitary casting adjustment detail.

- Minimum wall thickness of riser ring is 5- inches.
- Total number of riser rings shall not exceed two.
- An external chimney seal shall be provided on new manholes.
- Where a water tight casting is specified, as an alternative to adjusting rings, a cast-in-place section is required. See Standard Drawing [STR-16-1](#) for detail.