CHAPTER 9: CONSTRUCTION OF SPECIAL STRUCTURES

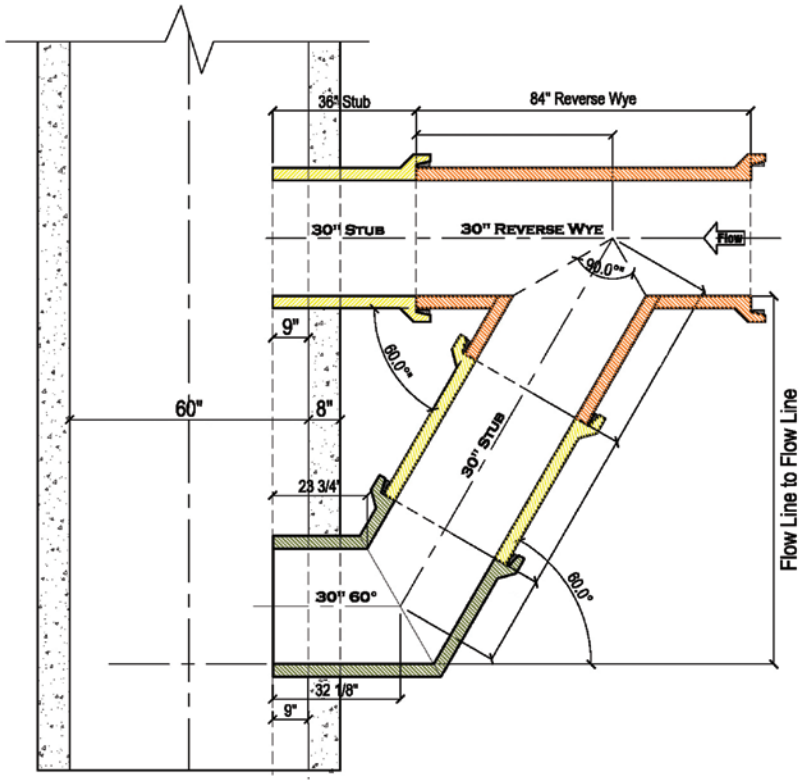

Figure 9-1: Drop Manhole Detail using a 30-inch VCP reverse wye fitting

Special Structures

Special structures and appurtenances are essential to the proper function of any complete system of sanitary sewers. These may include manholes, drop manholes, terminal cleanouts, service connections, inverted siphons, and other structures or devices of special design.

Many states have established criteria through their regulatory agencies governing safety, design and construction of appurtenances to sanitary sewer systems. In addition, each private and public engineering office usually has its own design standards, which have developed during years of experience. Therefore, many variations will be found in the design of these structures. The following discussion is limited to a general description of each of the various appurtenances, with special emphasis upon the features considered essential to good design.

Figure 9-2: Triple barrel VCP constructed under existing 72-inch conduit into a junction chamber

Manholes

Manholes are among the most common appurtenances found in a sewer system. Their principal purpose is to permit the inspection and cleaning of the sewers.

Most manholes are circular in shape, with the inside dimension sufficient to perform inspecting and cleaning operations without difficulty. A minimum inside diameter of 4 feet for circular manholes has been widely adopted for sanitary sewers.

Sewer manholes are usually constructed directly over the centerline of the sewer. Manholes should be located at pipe intersections, changes in directions, and not be more than 300 to 500 feet apart on long straight runs. The manhole may be constructed tangent to the side of the sewer for better accessibility. Consideration must be given to the need for introduction of cleaning and test equipment into the sewer.

The opening into the manhole must provide accessibility to the interior without difficulty. A minimum clear opening of 24 inches is recommended. The opening may be centered over the manhole, or constructed off-center in such a way as to provide a vertical side for the entire depth.

The flow should be carried in smoothly constructed U-shaped channels, which may be formed integrally with the concrete base. The height of the channel should be adequate to contain the flow. Adjacent shelf areas should be sloped to drain to the channel. Where more than one sewer enters the manhole, the channels should be curved smoothly and have sufficient capacity to carry the maximum flow. Where the sewer changes direction or size in a manhole, or a branch sewer enters a manhole, the surface of the sewage flow must be the same to prevent excess turbulence or backflow.

Figure 9-3: *Short stubs and/or flexible manhole connections should be used to provide flexibility*

Manhole Pipe Connections

Extreme caution should be exercised in the placement of manholes to assure an unyielding foundation. Settlement of the manhole may cause damage to the adjacent pipe. Short lengths (24-inch maximum) with flexible compression joints and/or flexible manhole connections should be used at the manhole walls to accommodate minor differential movement. A bell and spigot joint with a factory applied gasket or plain-end pipe joined with rubber compression couplings will provide the needed flexibility and water-tightness. Two points of flexibility should be used within 36 in. of each manhole connection.

This can be accomplished by using:

1. two short lengths (stubs of 24 in. or less) or
2. one short length and one flexible manhole connector (see Figure 9-4).

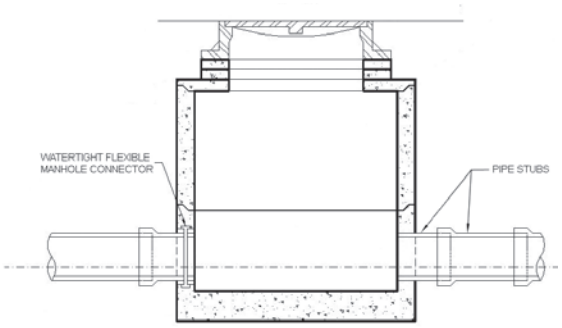

Figure 9-4: *Two points of flexibility should be provided within 36 inches of a structure.*

If a manhole connector is utilized, it is important that the pipe is centered in the connector and the tightening clamp torqued per the manufacturers' instructions in order to remain a flexible and watertight connector (see Figure 9-4). It is equally important that no mortar be placed between the pipe and the wall of the concrete structure. Both the use of mortar in this area and not centering the pipe would decrease the effectiveness of the connector to compensate for shear caused by settlement or ground movement.

The need for proper haunch support at and around manhole connections is just as important as it is for the entire pipeline (see Haunch Support section starting on page 6-6).

Manhole Frames, Covers and Steps

Manhole frames and covers are normally made of cast or ductile iron. All metal-bearing surfaces between the frame and cover, where subject to traffic, should be fabricated to ensure good seating. Locked or special bolted down covers may be used to prevent theft, vandalism or unauthorized entrance.

Steps must be made of corrosion resistant materials. Firm anchorage in the wall and provision in the design to prevent slipping are desirable objectives. Since there have been many serious failures of manhole steps the use of other confined space entry equipment is preferable and may be required.

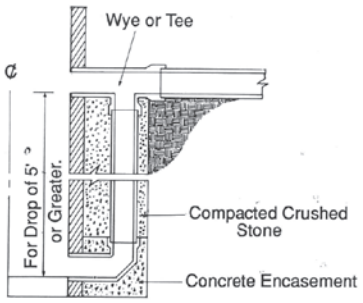

Figure 9-5: *Typical Drop Manhole (for 5 ft. or greater)*

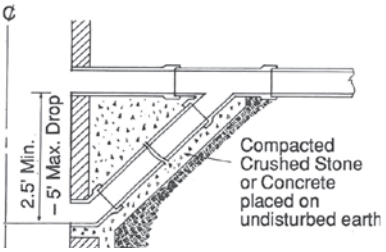

Figure 9-6: *Typical Drop Manhole (for 5 ft. or less)*

Drop Manholes

Differences in elevation of incoming and outgoing sewers, which would result in deposition of solids or nuisance to maintenance personnel, should be avoided. When it is necessary to drop the elevation of the sewer at a manhole, the drop may be made by means of an outside connection similar to that shown. Fitting dimensions govern the minimum vertical outside drop that can be made. The designer's judgment will determine, where the difference in elevation warrants using an outside drop instead of lowering the upstream or branch sewer. Support of the entire outside drop is desirable to protect it against damage during backfilling of the trench. Vertical curves may also be used to accomplish the change in elevation.

Safety Requirement for Entry into Confined Spaces

It is extremely important that qualified personnel perform entry into any confined space, such as a sewer manhole or structure. Complete knowledge of all regulations and safety equipment is required to ensure a safe, productive jobsite.

Terminal Cleanout Structures

Terminal cleanouts are sometimes used at the ends of branch or lateral sewers. Their purpose is to provide means for inserting cleaning tools, for flushing or for inserting inspection equipment into the sewer.

A terminal cleanout amounts to an upturned pipe coming to the surface of the ground. The turn should be made with bends to allow cleaning and inspection equipment. The diameter should be the same as that for the sewer.

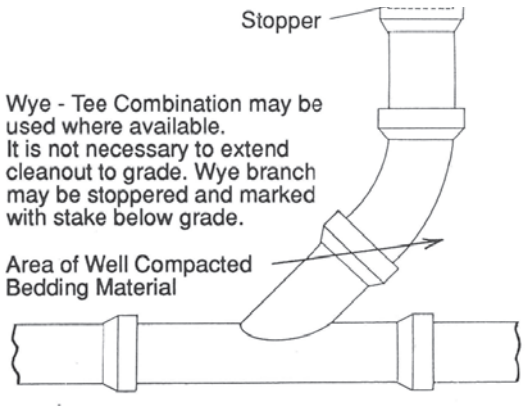

Figure 9-7: *Typical Cleanout Structure*

Terminal cleanouts are limited in usefulness and should never be used as a substitute for a manhole. They are permitted under some state regulations only at the ends of branch sewers, which may never be extended and must be within approximately 150 ft. of a manhole.