CURVILINEAR SEWERS

For many years, streets were constructed straight and true and traditionally oriented to the four points of the compass. Utilities have been placed in the street right-of-way generally paralleling each other and aligned with the street.

Post World War II construction of homes in large tracts and the forethought of city planners and developers took advantage of the esthetic value of curved streets. This street alignment not only offered a pleasant development but generally restricted traffic use to residents and reduced traffic speed resulting in safer neighborhoods.

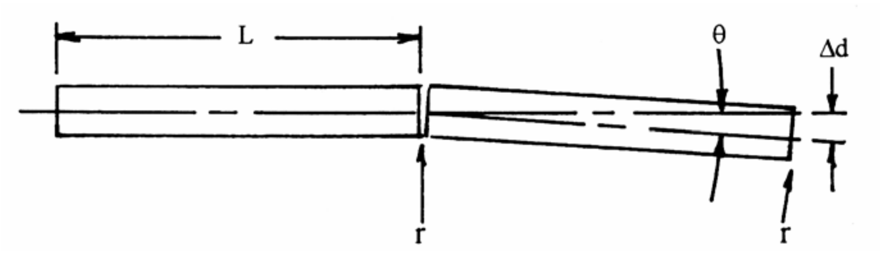
It made good sense to continue the alignment of all utilities with that of the street. The old method of straight runs of sewers in curved streets would repeatedly cross streets and other utilities. The shorter runs would also necessitate more manholes and additional cost.

New Factory Applied Joints Provide Angular Deflection for Curved Sewers

Through the 1950’s Vitrified Clay Pipe manufacturers developed new factory applied jointing systems. These joints were designed to allow angular deflection while retaining joint integrity. Sewer alignment could now parallel street centerlines by uniformly deflecting each piece of pipe to a predetermined radius. Radii of sewers are a function of the joint deflection and the pipe length. ASTM C *425* prescribes the limits of joint deflection as shown in the following table.

RADIUS OF CURVATURE AND ANGLE OF DEFLECTION

FOR CURVILINEAR SEWERS USING VARIOUS PIPE LENGTHS



1 – Nominal Pipe Diameter (Inches)	2 – Maximum Allowable Deflection, Δd in./ft. of pipe length	angle, θ	3 – Equation for Minimum Radius of Curvature, ft. (L=pipe length, ft)
3 to 12	1/2	2.4°	R = 24 (L)

15 to 24	3/8	1.8°	R = 32 (L)
27 to 36	1/4	1.2°	R = 48 (L)
39 to 42	3/16	0.9°	R = 64 (L)

Equation for use in determining radius, deflection angle per joint or the length of pipe in feet to be used.

$$r = (360°/\theta)\,(L/2\pi)$$

r = radius of the curved sewer in feet

θ = deflection angle per joint

L = length of pipe in feet

Sample Problem 1

To align the sewer in the curved street with other utilities, it has been determined that the design radius of the proposed 8-inch VCP sewer will be 125 feet. Determine the length and the deflection angle of each piece.

We are planning to use 8-inch diameter x 6-foot long pipe on this project. From column 3 of the table, the minimum radius for this diameter and length of pipe is r 24 (6) = 144 feet. Since the sample problem design radius of 125 feet is less than the calculated minimum radius of 144 feet, a pipe length of 6 feet is too long. Referring to column 2, the maximum allowable angular deflection for 8-inch pipe is 2.4 degrees. Use 2.4 degrees in the equation for θ and solve for the maximum pipe length.

$$125 = (360°/2.4°)\,(L/2\pi) \qquad L = (125)(2.4)(2\pi)/360 \qquad L = 5.24'$$

Note: Standard length pipe less than the computed length (L) should be used.

Sample Problem 2

If the design radius of the proposed 15-inch diameter sewer will be 220 feet, determine the deflection angle of each piece of pipe.

Since the design radius of 220 feet is larger than the minimum prescribed in column 3, r = 32 (6) = 192, the 6-foot long pipe supplied may be used. We may now use 6 feet in the equation for L and solve for the deflection angle θ.

$$220 = (360°/\theta)(6/2\pi) \qquad \theta = (360)(6) / (220)(2\pi) \qquad \theta = 1.56°$$

For Ease of Installation

From Sample Problem 2, determine the distance each 6-foot long pipe needs to be deflected from a straight line in inches.

$$\Delta d = \tan\theta\,(L)(12) \qquad \Delta d = \tan 1.56°\,(6)(12) \qquad \Delta d = 1.96''$$

Before designing curvilinear sewers, contact your local manufacturer of VCP for assistance.