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TECH NOTES

DEFLECTION: DOES IT MATTER?

In contrast to rigid pipe which is manufactured to remain round due to inherent structural strength, flexible pipe has little inherent structural strength and depends to a large extent on a properly compacted envelope of embedment materials to prevent excessive deflection. Some claim that deflection is necessary to make the system function structurally. Too much deflection however, is neither good for the pipe, its hydraulic performance or long term prospects for the system.

Deflection in flexible pipe is seldom a neat top to bottom decrease in vertical pipe height. Depending on the embedment material, level of compaction, stability of the insitu soil, and the skill of the installer, the pipe may distort into an elliptical, egg, kidney or other shape. Is deflection or distortion of the pipe in any form desirable? In this edition of TECH NOTES, we will consider just two aspects of deflection: Structural Design and Hydraulic Performance.

STRUCTURAL DESIGN

Many specifications permit no more than *5* % deflection for flexible pipe. This limit is based on several criteria. Some claim that it is possible to build a flexible pipe system with less than *5%* deflection. To do this however, the contractor must use an approved embedment material in the proper quantities. He must consolidate the material in the pipe zone to the specified density and excavate the trench width to an amount needed to provide effective side restraint to the pipe. Keeping the trench narrow, which is common with rigid pipe materials, may not provide sufficient sidefill restraint for flexible pipe. When the insitu material is less dense than the embedment material, the minimum trench width may have to be as much as six pipe diameters wide to provide adequate side restraint. The envelope of material in the immediate pipe zone or close to the pipe probably controls the short term deflection of the pipe while the stability of the insitu material just outside of the immediate pipe zone may be the largest controlling factor in long term deflection. This may explain why deflection varies so much along a pipe line and why some flexible pipe lines seem to stabilize while others continue to deflect.

More evidence is coming to light regarding the ageing of PVC sewer pipe. In some instances the pipe seems to become brittle. The level of stress, deflection, age and exposure of pipe before installation, filler content and operating temperature are factors that are not completely understood and may also influence the long term performance of the pipe.

HYDRAULIC DESIGN

An increase in the horizontal dimension will usually be accompanied by a flattening of the invert. At low flows, a flat invert will result in a corresponding decrease in flow velocity. A pipe designed to a minimum scour velocity for circular pipe may deposit solids in deflected plastic pipe.

Distortion of the pipe cross section may result in an uncertain hydraulic flow. Even when sewer flows are properly designed, deflection or distortions can cause a hydraulic jump in the flow which not only reduces the line capacity but the resulting turbulence releases otherwise entrapped sewer

gases. Sags in the line which are common to long length pipe also decrease flow and contribute to hydrogen sulphide generation.

A stable uniform hydraulic flow is not only intended to move sewage efficiently, but it is also a means to permit sewer gas conveyance.

SUMMARY

Simply put, deflection or distortion, does more than negate the engineers' hydraulic design. It may result in an uncertain flow, a questionable "n" factor and an unpredictable future capacity. A pipe should be capable of staying round throughout its service life. It simply is not reasonable to expect hydraulic performance over the life of the sewer without structural performance as well.