PVC PIPE WELL-SUITED FOR DEEP-BURY APPLICATIONS

The PVC Pipe Association frequently responds to questions regarding the suitability of PVC pipe for deep-bury projects. The misconception is that the pipe will not hold up over time under large earth loads. However, installations throughout North America have shown that PVC pipelines perform well at depths of more than 40 feet. Furthermore, decades of successful field experience have validated the design methods used for deep-bury PVC pipes.

BURIAL DEPTH NOT A DESIGN CONSIDERATION FOR PVC PRESSURE PIPE

Pressure pipe does not need to be laid on a slope to provide positive drainage. As a result, pressure pipelines typically follow ground contours while maintaining a minimum depth of cover based on frost-depth requirements. For this reason, even in very cold climates, the maximum depth for pressure applications does not typically exceed seven feet. This is not considered deep burial.

Due to owner preferences, thicker-walled PVC pressure pipe may sometimes be used for gravity sewer projects instead of the typical DR 35 and DR 26 sewer pipes. Pressure pipe made to AWWA C900 or ASTM D2241 does not have a practical bury limit for commonly used DRs (DR 14, 18, or 21). These DRs provide sufficient pipe stiffness with minimal ring deflections (ovality) in deep-bury situations in moderately compacted embedment soils. However, to achieve a more economical design without thicker-walled piping, utilities would usually be better served by improving the embedment conditions and using PVC gravity sewer pipe.

PVC NONPRESSURE PIPE AT MORE THAN 40-FOOT BURIAL

Nonpressure pipe is laid on a slope to provide drainage. This means that sewer pipe can sometimes be more than 50 feet below the ground surface. The following table shows the maximum depth of burial of PVC pipe at 5% and 7.5% deflection using an average embedment (E' = 1,000 psi).

Maximum Depth of Cover for PVC Sewer Pipe with E' = 1,000 psi			
Pipe DR, dimensionless	Pipe Stiffness, psi	Maximum Depth of Cover at 5.0 % Pipe Deflection, feet	Maximum Depth of Cover at 7.5 % Pipe Deflection, feet
35	46	40	61
26	115	47	70

Two notable projects where deep-bury PVC sewer pipe has stood the test of time:

- Monroe Township, NJ: 1995 project – more than two miles of 30-inch PS 46 sanitary sewer pipe was installed at depths that ranged from 20 to 52 feet. Click here.
- Arlington, TX: 1986 project – more than 18,000 feet of 18- through 27-inch PS 46 sewer mains were installed at average burial depth of 35 feet, with maximum depth of 45 feet. Click here.

OVERDEFLECTION NOT A CONCERN FOR DEEP-BURY PVC SEWER PIPE

Gravity sewer pipes are often limited by project specifications to a maximum installed ring deflection (ovalization) of 7.5%. However, failure of PVC pipe by reverse curvature does not occur until 30% ring deflection or more. This provides at least a 4:1 safety factor against failure. (If deflection is limited to 5%, the safety factor is at least 6:1.) Engineering design should consider ring deflection limits and corresponding safety factors for all flexible pipe materials. Design engineers are encouraged to use PVCPA's External Load Design Calculator. Additional engineering and research information:

- *Uni-Bell Technical Report UNI-TR-1* "Deflection: the Pipe/Soil Mechanism," Click here.
- *Handbook of PVC Pipe Design and Construction,* Click here.
  - Handbook Chapter 6 – "External Loads on Buried Pipe" explains the difference between rigid and flexible pipes' response to loads and shows how live loads are transmitted to buried pipe.
  - Handbook Chapter 7 – "Design of Buried PVC Pipe" provides a detailed explanation of concepts such as pipe stiffness, soil/structure interaction and PVC pipe performance limits.