PIPE – STRUCTURE CONNECTION

SUMMARY
Differential settlement where a pipe connects to a rigid structure can deform or crack the pipe at the interface. The pipe must be well supported at this connection to minimize any differential settlement. Flexibility at this interface is advised. Accordingly, flexible boots, shaped soil foundation, short sections of gasketed pipe, and/or flowable fill should be utilized. Preferably, all of these counter measures should be used.

Where a pipe connects to a rigid structure, such as a wall, manhole, junction boxes, etc., there is potential for significant differential settlement of the pipe next to the structure. The structure is very stiff and the soil supporting the pipe is much less stiff. Typically the pipe is connected to the structure with no soil support for a few feet. Getting the proper soil support is tenuous because compacting underneath a pipe is very difficult. (see Technical Note on “Compacting Under a Pipe”) Then when backfill soil is placed and compacted over the pipe, the pipe may crack or deform due to the shear load on the pipe next to the structure, as shown in Figure 1. This is a very common problem and the damage may not be obvious until much later because the soil load on a pipe does not reach a maximum for several months after backfilling.
Differential settlement may be minimized at locations where the pipe connects to rigid structures by one, or more, of the following methods:

1. Attach the pipe to the structure with a watertight, yielding boot that permits rotation and translation, or with any specially designed flexible joint, as shown in Figure 2.

![Flexible Connector](image)

Figure 2  Flexible Connector

2. Shape the foundation to avoid abrupt changes in support, as shown in Figure 3.

![Shape Foundation Soil](image)

Figure 3  Shape Foundation Soil
3. Place a gasketed joint within a half-pipe diameter of the face of the structure (or within 0.5 m (18 in) whichever is larger), as shown in Figure 4, and a second gasketed joint within one to two pipe diameters of the face of the structure (preferably with a joint near the point where the pipe support changes from undisturbed to disturbed foundation soil). A system comprised of two gasketed joints and a short length of pipe can accommodate differential settlement up to the rotational capacity of the joints.

![Figure 4  Pipe Structure Connection](image)

4. Construct an intermediate-stiffness bedding such as flowable fill, or high density soil next to the structure as a transition area, as shown in Figure 5. The only method of obtaining high density is to use clean, cohesionless gravel and compact by the “saturation and vibration” technique.

![Figure 5  Flowable Fill as Transition](image)
Most of the time, the pipe is already connected to the structure so there is space under the pipe as shown in Figure 1. It is difficult to compact beneath a pipe using impact, kneading, or pressure. By using the “saturation and vibration” technique as described in ASTM F 1668, cohesionless soils can be compacted. However, if this method is not already being used on the project, it may be too expensive to mobilize to use this method only for pipe-structure connections. The most effective way is to use flowable fill.

The recommended mix for flowable fill for pipe embedment is a half-sack mix that has a 28 day strength of 50 to 100 psi. For one connection, ordering from a ready-mix plant is practical. However, for larger quantities of flowable fill, on-site mixing using native soils, or Class C flyash, can be more economical.

5. The recommended method for constructing a structure-pipe connection is to use all of the above:
   - Flexible connector
   - Flexible joints
   - Foundation shaping
   - Flowable fill

References:
