COMPACATION UNDER A PIPE

SUMMARY
Compacting soil underneath a pipe can be difficult.
There are two different methods that can provide good support under a pipe:
Saturation and vibration of clean, cohesionless soils
Flowable fill
At pipe-structure connections the poor support for the pipe can lead to damage of the pipe at the structure.

DUMPING SOIL AROUND PIPE

As shown in Figure 1, dumping in soil can leave a low density area right beneath the pipe. And it is very difficult to compact under the pipe. Even compacting the soil on either side of the pipe will leave a low density area beneath the pipe as shown in the figure.

Dumping from a height can densify some cohesionless soils. While not at the maximum density, the density will be higher than the minimum.

While dumping from a height can result in an in-place density higher than minimum density, the pipe keeps the particles from densifying beneath the pipe because the particles are just rolling into place. A low density area just below the pipe will be created.

DUMPED

COMPACTED

Figure 1   Dumping Soil Around a Pipe

Figure 2   Compacting Soil Around a Pipe
PIPES NEXT TO STRUCTURE

Pipes are often connected to structures leaving a space all around the pipe. Dumping or compacting soil around the pipe will not give good support to the pipe as discussed above. The result is a poorly supported pipe attached to a rigid structure on one end and the native soil on the other. The effect is like a beam supported just on the ends. Any load on the pipe will be resisted mainly by the beam strength of the unsupported pipe.

Figure 3 Pipe-Structure Connection

Proper methods to support the pipe and prevent differential settlement are discussed in a separate TECH NOTE “Pipe-Structure Connections.”

DENSITY AND STIFFNESS

Any dumped sand and gravel is about at its lowest density which is about 80% of the maximum density. This means that 10-20% settlement can occur. See Technical Note “Density and Stiffness.”

HOW TO COMPACT UNDER A PIPE

The most successful method of compacting soil beneath a pipe is use cohesionless soil and densify it using the saturation and vibration technique. Just enough water is added to the soil to act as a lubricant and an internal vibrator is repeatedly inserted and removed from the soil. This method has been use to compact lifts up to 7 to 8 foot thick and to move the soil under the pipe. For more discussion, see Chapter 10 in Pipeline Installation (Howard 1996). A video of the saturation and vibration method of compacting soil can be seen at AmsterHoward.com under links.

The best method of providing proper soil support is to use flowable fill. The flowable fill can be used to fill the space underneath the pipe. The flowable fill should extend up to 0.25 of the outside diameter of the pipe for rigid pipe and 0.70 of the outside diameter for flexible pipe. Most specifications require that the flowable fill extend to 6 to 12 inches above the top of the pipe. Flowable fill is discussed in more detail in Chapter 13 of Pipeline Installation.
References: