CHAPTER 3

TRENCH EXCAVATION

Excavation

The trench is generally excavated in the upstream direction. Any variation in this procedure should be at the direction of the engineer. It is important that the line and grade shown on the plans be followed.

Excavated trenches should be straight, to the required grade with the width (measured at the top of the pipe) held to a minimum. Adequate room for proper haunching should be considered during design.

Line and Grade

In most cases, the engineer establishes line and grade and places grade stakes and/or other reference markers to show station and depth of pipe invert. The contractor works from these markers to dig the trench at the specified location and depth.

Figure 3: *A common pipe laser in use*

A laser is commonly used to establish alignment of pipe and grade of trench bottom, bedding materials and pipe invert.

The laser sends a straight beam of laser light from a unit which has been positioned for proper line and grade to a target with predetermined reference marks.

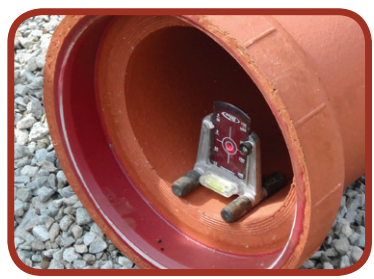

Figure 4: *Laser target used to confirm final alignment.*

Trench Walls

Where ground conditions are such that trench walls may not remain vertical, the contractor may elect to use sloping side walls or to use shoring, sheeting or trench boxes to support the trench wall.

In all cases, the critical dimension is the excavated trench width (dirt to dirt) measured at the top of the pipe (see Specified Width illlustrations in Figure 5). The trench width at the top of the pipe must not exceed the specified width as shown on the design drawings. Even a small increase in trench width causes a large increase in loading. For example, if a 2'0" trench width is increased only 6", the backfill load is increased by about 50%.

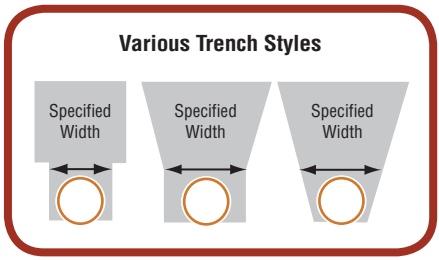

Figure 5: *No matter which trench style is used, trench width as measured from dirt to dirt at the top of the pipe is critical.*

In deep cuts, a narrow step-trench or sub-trench may be excavated after a wider trench is used above the level of the top of the pipe. A vee or modified vee trench may also be used. In all cases, the specified trench width at the top of the pipe must not be exceeded without written approval.

Sheeting, Shoring and Moveable Trench Boxes

It may not always be necessary to use shoring, sheeting or trench boxes. The primary concerns are for personnel safety and strict observation of all applicable regulations. Shoring and sheeting also retains trench width integrity and reduces the risk of cave-ins.

Figure 6: *Trench sheeting and spreader bars*

Timber sheeting placed in the pipe zone shall be left in place or cut off, not lower than the top of the pipe. Pulling timber sheeting creates voids at the sides of the pipe that reduce the side support provided by the soil. Thin steel sheeting may be pulled, provided no voids are created and the pipe bedding and haunch areas are not disturbed.

Steel trench boxes are used for trench construction and safety. If possible, the trench box should ride above the top of the pipe, on the bottom of a wider step trench. Narrow backhoe buckets are available to maintain design trench width up to the top of the pipe. In this case, dragging the trench box forward does not interfere with pipe bedding and cannot pull the pipe joints apart.

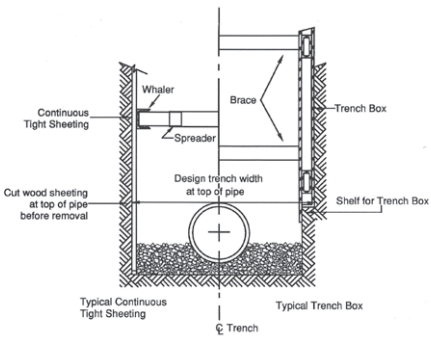

Figure 7: *Trench sheeting and spreader bars*

If the trench box rides below the top of the pipe, care must be taken to protect the integrity of the pipe bedding and haunch areas, particularly when movement of the trench box leaves a void in the pipe bedding. Care must also be taken to ensure that movement of the trench box does not pull the pipe joints apart. A suggested method would be to secure the pipe with a wood cross block, cable and winch at a downstream manhole.

Dewatering

Water must be removed from the trench prior to establishment of a firm and unyielding foundation and before placement and final grading of the bedding under the pipe barrel.

The trench must be kept dry during all phases of pipe installation.

The ground water table can be lowered with well points wherever soil conditions permit. They must be located at intervals dictated by soil properties and placed reasonably close to the trench walls. They should be sunk to a depth below the elevation of the trench bottom (see Figure 8).

Several well points can be joined together so that one pump can handle a group of points.

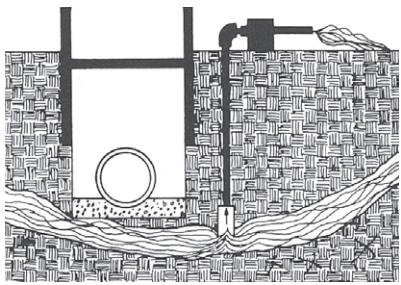

Figure 8: *Lowering the ground water table with well points*