year period. For shallow burial conditions, under repeated traffic and in various bedding conditions, deflections were generally in the 2% range. Pea gravel was more effective in reducing deflection than lean clay. The report concluded the following: “A cover height of 12 in. is recommended for PVC pipe when subjected to highway loads (18-kip axle loads), 18 in. for pipe subjected to heavier highway loadings and light aircraft traffic (gross weight not to exceed 30,000 lbs) and 24 in. of cover is recommended for traffic of light to medium (320,000 lbs gross weight) aircraft.”

The effort by the Ontario Ministry of Transportation, undertaken in 1992, included the testing of PVC profile pipes under shallow cover. One was a 30 in. (750mm) closed profile pipe while the other was a 24 in. (600mm) open profile pipe. The 30 in. pipe had a granular cover of 8 in. while the 24 in. pipe had 18 in. of granular cover. Mounted to the underside of a trailer, a hydraulic ram was used to apply the load. The footprint of the load pad was two 10 in. squares, simulating a dual truck tire. Four linear variable displacement transducers (LVDT) were used to monitor deflections in each pipe. The 30 in. pipe displayed a maximum deformation of 3.2% under a loading of 56,200 lbs (250 kN), with less than 1% residual deformation. The 24 in. pipe had a maximum deformation of 2% under the same loading. This study clearly highlighted the ability of PVC pipe to withstand large loads even under shallow cover.

As a general rule, when traffic loads are anticipated, the Uni-Bell PVC Pipe Handbook recommends the use of Class I (crushed rock), or Class II (clean sands and gravel) soils, compacted to 95% Proctor density, when burial within a depth of one to three feet is required.

We hope this article has been helpful in clarifying the engineering principles that govern the successful installation of PVC pipe in both deep and shallow burial conditions, and dispels doubts about PVC’s capability to perform well under these adverse conditions.

References

LESSON #1: OVERSIZED SADDLES
Problems can arise from selecting the wrong saddle when tapping PVC pipe. In order to receive a passing grade, a tapping student can rely on any of the following:

“All service clamps or saddles shall provide full support around the circumference of the pipe. Because the outside diameter manufacturing tolerances for PVC pipes are tighter than those for compatible ductile-iron pipes, only tapping saddles manufactured specifically for PVC pipe shall be used.” (Section 6.4.2.1 of AWWA C605)

“Service clamps or saddles used for attaching service connections to PVC pipe should: Provide full support around the circumference of the pipe. Be designed for use with PVC pipe.” (Handbook of PVC Pipe)

“Service clamps should not ... have a clamping arrangement that is not fully contoured to the outside diameter of the pipe.” (UNI-PUB-8)

The scholars in the group may want to not only know the right answer, but also want to know why. Some saddles are manufactured to cover a range of outside diameters in order to accommodate more than one diameter regimen. Often times, the outside diameter of the PVC pipe falls on the low side of the range, and the bolts on the saddle take up the slack. When an oversized saddle is used on PVC, the saddle contacts the pipe at six and twelve o’clock and leaves a gap at three and nine o’clock. (See Figure 1.) The uninformed student may not realize that the wrong saddle was purchased and tightens the bolts until the gap is gone. Unfortunately, by doing so, he will...

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Induced additional stresses in the pipe. Using the correct saddle, one that conforms to the outside diameter of the pipe, such stresses can be avoided altogether.

The “A” student also checks to make sure the saddle provides sufficient bearing area. AWWA C605 recommends a strap width of two inches for taps up to one inch. A width of three inches is recommended for taps from 1.25 to 2.00 inches.

**LESSON #2: SELF-FEEDING SADDLE TAPPING MACHINES**

Like any other subject, there is some vocabulary to master. Those who understand the terminology will not have any difficulty with the following passage.

“The tapping machine shall provide a standard ratchet handle on the boring bar and be of a design such that cutting and tapping are controlled by a feed nut and yoke.” (UNI-PUB-8)

Put another way, the boring bar should be advanced manually, instead of being advanced automatically by a threaded rod. Figure 2 shows an example of a machine that meets this recommendation and an example of a machine that does not.

**LESSON #3: WRONG BIT**

Using the correct cutting tool is probably the most important lesson of all. Do not drill a hole in PVC pipe with a twist drill, auger bit, or spade bit.

UNI-PUB-8 lists similar recommendations for saddle tapping:

- “The machine must operate with a cutting/tapping tool suitable for PVC pipe. This tool should be of a shell-type design, have a minimum of two slots, and shall retain the cut coupon after penetrating the PVC pipe wall.”

UNI-PUB-8 lists similar recommendations for saddle tapping:

- “This tool shall be of a shell-type design, have a minimum of two slots, shall retain the cut coupon after penetrating the PVC pipe wall, and be designed to accommodate walls as heavy as DR 14 (Pressure Class 200, AWWA C900).”

For extra credit, explain why two or more slots are recommended. Those who discussed eccentricity get ten points added to their final. If there is only one slot, there may be difficulty in initiating the cut. When the leading tooth of the cutting tool contacts the pipe, there are two possible outcomes:

- Possibility 1. The cutting tool does not ‘walk’ and there is no wobble when the boring bar is rotated.
- Possibility 2. There is some pivoting about the point where the tooth contacts the pipe surface, which results in some ‘walking’ of the tool and some wobble when the boring bar is rotated.

Having more than one slot eliminates the unbalanced forces and the creation of a pivot point. This makes it easier to initiate the cut. By following the recommendations, the scholar has made his job easier.

When it comes to tapping PVC, the Association’s goal is to make the words of Nicholas Ling a reality: “Ignorance is a voluntary misfortune.” The many graduates in the field have been of immense help with this goal. They share their knowledge and expertise with the new person on the crew. And in the final analysis, it is they who are the real teachers.

We congratulate the many successful graduates. Class dismissed.

For all your educational tapping resources visit our website at:  
[www.uni-bell.org](http://www.uni-bell.org)