Plastic Fill Height Table Pitfalls

American Concrete Pipe Association
www.concretepipe.org

An educational document from the American Concrete Pipe Association for users and specifiers

Plastic pipe fill height tables published by the manufacturer are often erroneously used for project design while manufacturers in fact state that the published tables should be used only for general informational purposes, not for design. Critical assumptions must be understood behind the development of these tables including Water Table Impact and Trench Installations. This ePipe explains the reasons why these tables are not to be used for actual project design.

- If the water table is above the top of the pipe and at or above the ground surface:

$$P_{sp} = \frac{\left(H + 0.11\frac{D_o}{12}\right)\gamma_b}{144} \qquad (12.12.3.7\text{-}1)$$

- If the water table is above the top of the pipe and below the ground surface:

$$P_{sp} = \frac{1}{144}\left[\left[\left(H_W - \frac{D_o}{24}\right) + 0.11\frac{D_o}{12}\right]\gamma_b + \left[H - \left(H_w - \frac{D_o}{24}\right)\right]\gamma_s\right] \qquad (12.12.3.7\text{-}2)$$

- If the water table is below the top of the pipe:

$$P_{sp} = \frac{\left(H + 0.11\frac{D_o}{12}\right)\gamma_s}{144} \qquad (12.12.3.7\text{-}3)$$

Water Table Impact:

According to AASHTO LRFD Code 12.12.3.7 – Soil Prism, there are three different equations (right) to utilize in design based on the elevation of the top of pipe relative to the elevation of the water table. Not knowing this exact project variable for each section of a line, the design engineer cannot use the provided manufacturer fill height tables if water tables are present since this variable is not addressed in the tables.

Additionally, if there is a concern of a varying and/or seasonal water table elevation, AASHTO LRFD Code 12.12.3.8 accounts for this uncertainty with a designer supplied value for K_{wa} (factor for uncertainty in level of groundwater uncertainty) which can be as high as 1.3 to be conservative. Published manufacturer fill height tables specifically note that the tables have no water table present which is commonly not the case.

Trench Installations:

A second design omission within the AASHTO LRFD Section 12 code deals with a lack of trench installation investigation. The impact of this lack of investigation is compounded when a trench box is utilized for a particular installation. A critical component of the structural capacity of the soil-plastic pipe system is dependent on the design of the backfill envelope where the side supporting fill must be strong enough to support the horizontal deflection. When a trench box is utilized and placed within the pipe zone, this all important side fill is dramatically disturbed when the box is moved to the next section. This action creates voids in this critical haunch and side embedment zone thereby reducing any vertical arching benefit, reducing the soil column strength on each side of the pipe, and subjecting the pipe to strains beyond those allowed by design. Therefore, it is not conservative to simply assume that a trench installation is equal to or better than the embankment condition referenced in the AASHTO LRFD Code.

Next Steps:

Given the important information above, the engineering community must ***design*** projects (fill height tables are not sufficient) with appropriate consideration to water table influence and the impact of trench box usage. The AASHTO C12.12.3.5 commentary warns, "The VAF approach is only developed for embankment load case. No guidance is currently available to predict the reduced loads on a pipe in trench conditions." The engineering community will help ***reduce their liability*** when specifying a plastic pipe system by following the ***very important*** steps outlined above for ***each and every*** project.