

The Thermoplastic Pipe Profile Predicament



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

AASHTO's Thermoplastic Pipe Load & Resistance Factor Design (LRFD) requires many inputs from the design engineer ranging from a Deflection Lag Factor to an Installation Factor. Most of the input decisions must be made by the engineer on a project by project basis. One very important design variable, however, has to be provided by the plastic pipe manufacturer; the idealized pipe wall profile for each size of pipe which varies from manufacturer to manufacturer, even region to region from a given manufacturer. This ePipe explains why the idealized pipe wall profile for each size of pipe is critical to the project design calculations and what should be done to obtain correct values.

Plastic Pipe Wall Profiles - No Two Are Alike: (same can be said for fill height tables)

According to the AASHTO LRFD code 12.12.3.10.1 Resistance to Axial Thrust, "Elements of profile wall pipe shall be designed to resist local buckling. To determine local buckling resistance, profile-wall geometry shall be idealized as specified herein and an effective area determined in accordance ..." The section goes on to explain that the profile shall be "idealized" into straight elements and resemble a profile similar to the figure below.



Pipe wall profiles provided by manufacturers are unique to each facility and to each different pipe size they offer. The effective area, A_{eff} , is based on a design theory adopted from the cold-formed steel industry. "This theory assumes that even though buckling is initiated in the center of the plate element, the element still has substantial post-buckling strength at the edges where the element is supported." To perform the calculations required in the LRFD standard using the idealized wall profiles, the design engineer must know and understand critical factors, including but not limited to "*b*" element effective width, " λ " or slenderness factor, and " ρ " or effective width, all which vary significantly with profile geometry incorporated in pipe from a given manufacturer / facility.

An alternate method to determine the effective area was added to the LRFD code where the effective area can be calculated by a procedure called the stub compression test per AASHTO T341. If chosen, the design engineer should incorporate the test as a requirement and the test data should be provided by the plastic pipe manufacturer for the specific profile provided on the project. Using this method, the effective area A_{eff} shall satisfy the following:

$$A_{eff} = \frac{P_{st}K_{t}}{F_{u}} \le A_{g}$$

Critical Design Input:

Pipe wall geometry plays an important role in the structural performance of a plastic pipeline. If the engineer allows plastic pipe in the specifications, consideration must be given to the fact that each pipe wall profile is different and requires a unique A_{eff} for each size of pipe from each individual pipe manufacturer. This data is required and must be accurate in the structural calculations – generic fill height tables will not address all available profile offerings. 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.