Trust but Verify

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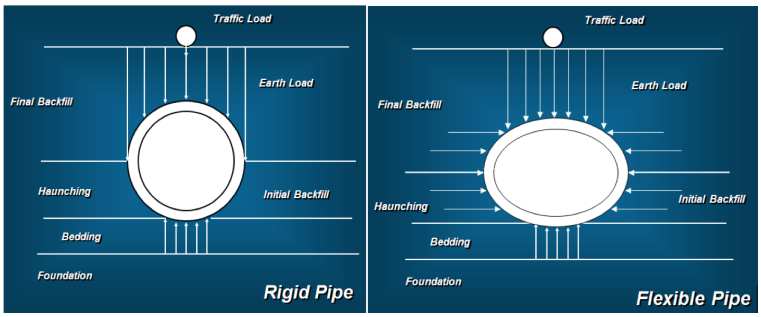
An educational document from the American Concrete Pipe Association for users and specifiers

Not all pipe types are the same; neither are their design assumptions. Flexible pipe requires a strong side-fill to develop strength as it shortens vertically, deflecting outward to engage the side-fill as a **Column** to carry some of the vertical load; and as a **Bearing** to resist horizontal deflection. Rigid pipe relies very little on the horizontal support given by the side-fill soils, and provides the strength within the pipe wall composition. Based on this difference, installation assumptions should not be the same.



Installation Differences:

Rigid pipe – Embankment: worst case for Rigid

- Side fill soils deflect more than pipe / soil prism
- Vertical load increases due to downward drag; Lateral support increases as soil settles (arrows in Fig 1 and Fig 2)
- Rigid Vertical Arching Factor (VAF) accounts for this **increase – 1.35 to 1.45** (AASHTO Table 12.10.2.1-3).

Rigid pipe – Narrow Trench:

- Soil prism load reduced by friction on the side walls – reduces horizontal pressure (no arrows)
- AASHTO rigid design - benefit is typically ignored (VAF = 1.35 to 1.45 – not less than 1.0)

Flexible pipe - Embankment: Is this worst case?

- Side-fill soils assumed to develop stiff columns
- Flexible VAF varies from 0.2 (best) to 1.0 (worst)
- Flexible pipe stiffness less than soil column stiffness
- Vertical soil columns / horizontal strength of the side-fill *improves with overburden pressure*

Flexible pipe - Narrow Trench:

- AASHTO Commentary: "It is conservative to use the VAF approach as presented for embankments."
- Lack of research to verify this assumption
- Vertical load on side-fill soils is reduced / soil-column stiffness and the lateral resistance also reduced
- **Flexible VAF may be higher than assumed to the point that it may be greater than 1.**

Figure 1 Positive Projecting Embankment

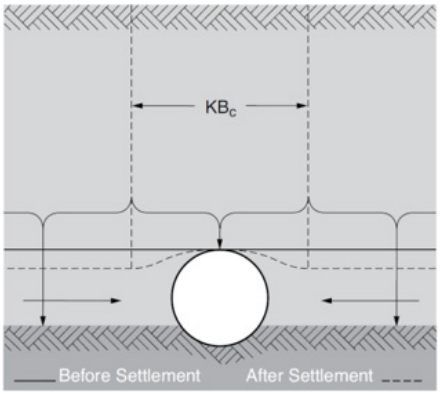


Figure 2 Wide Trench Condition

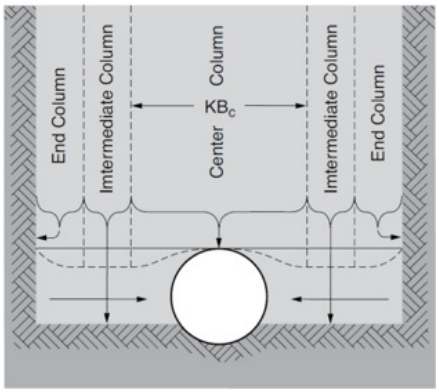
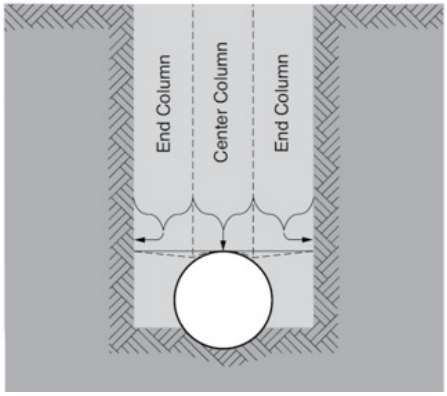


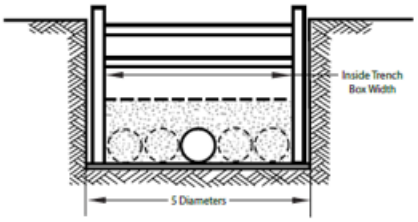
Figure 4 Trench Condition



Dr. A. Moser in the book Buried Pipe Design 2nd Edition states: "*. . . true trench condition may or may not result in significant load reductions on flexible conduit . . .*" and further "*. . . a flexible pipe develops a large percentage of its load-carrying capacity from passive side support, this support must be provided, or the pipe will tend to deflect until the sides of the pipe are being supported . . .*" **Narrow trenches are impractical to install without disturbing the side fill (trench boxes).**

Until research is completed to verify the embankment VAF assumption, trenches should not be allowed or minimum trench widths established. See Manufacturer's Recommendation.

Plastic Pipe Trench Box Detail



"If it is necessary for a trench box to be dragged through a trench, do not raise the box more than 24" above the work surface. Another alternative for when the box will be dragged is to use a well-graded granular backfill material at least two diameters on either side of the pipe and compact it to a minimum of 90% standard Proctor density before moving the box." *ADS Technical Note, TN 5.01, March 2009*

Failure to adhere to these trench box requirements or other HDPE manufacturer recommended procedures could void the product's warranty, increase the project's risk of failure, and jeopardize your professional liability.