Ductile Iron Pipe

A. Introduction

Ductile iron pipe is used primarily as water main, but is also used as force main and for some specialized gravity flow situations. Since the pipe is constructed of ductile iron, it can deflect without failing and behaves similar to a flexible plastic pipe. However, ductile iron pipe has some additional properties that warrant a slightly different design methodology than previously described for flexible plastic pipes.

B. Pipe Design

The first step in analyzing a ductile iron pipe for structural capacity is to determine what pipe thickness to use. Currently, there are two different pipe classifications for ductile iron pipe: Pressure Class and Thickness Class. SUDAS requires Thickness Class 52 pipe for all water main 24 inches or smaller. Unlike PVC pipe, ductile iron pipe does not follow a standardized diameter ratio (DR), so there is no easy method of determining the wall thickness based upon diameter. Pipe standard AWWA C151 indicates the nominal wall thicknesses for Class 52 pipe. However, the values listed in the AWWA standard are not the values used for design purposes. The AWWA values include a casting allowance to ensure that negative thickness deviations do not occur during the casting process. The casting allowance varies from 0.05 to 0.09 inches, depending on diameter. A service allowance of 0.08 inches is also included in the wall thickness to account for material loss from the pipe over its service life. These values are subtracted from the stated wall thickness to determine the design thickness.

Once the design thickness of the pipe is known, the pipe can be analyzed for deflection. Just like flexible pipes, ductile iron can undergo significant deflections without damage. However, the allowable deflection for ductile iron pipe is normally limited to 3%. This limitation is imposed to protect the cement-mortar lining on the inside of ductile iron water pipe.

In addition to deflection limitations, the ring bending stress in the pipe must also be determined. Maximum ring bending stress occurs at the invert of the pipe. If the stress exceeds the yield stress of the ductile iron material, the pipe will undergo permanent deformation.

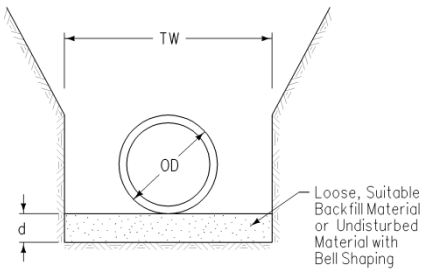
The equations and procedures for determining pipe deflection and ring bending stress are provided in the Ductile Iron Pipe Research Association's (DIPRA) publication "Design of Ductile Iron Pipe."

C. Bedding

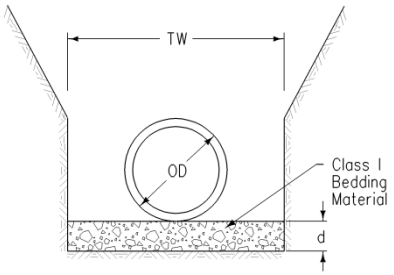
For shallow installations, ductile iron pipe can be installed without granular bedding material. However, the sidewall support from granular bedding material allows ductile iron pipe to carry greater loads then the pipe could by itself. This is an important consideration for deep installations. For example, the maximum depth of bury for a 24 inch Thickness Class 52 ductile iron pipe in a Class P-1 bedding (native soil) is 16 feet. The allowable depth of bury for the same pipe in a Class P-3 bedding (crushed stone encasement) is 38 feet.

Figure 9B-4.01 shows the standard bedding classes for pressure pipe installations. Refer to Section 9B-3 - Flexible Plastic Pipes, regarding bedding requirements for ductile iron pipe when used in a gravity flow installation.

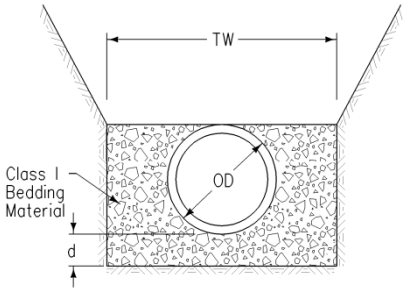
Figure 9B-4.01: Pressure Pipe Bedding Types



Class P-1



Class P-2



Class P-3