

NON-REINFORCED PIPE

Non-reinforced pipe exists in several forms: precast concrete pipe, clay pipe, asbestos cement pipe and cast-in-place concrete pipe. The use of non-reinforced concrete pipe dates back to 800 B.C. when main sewers were installed in Rome. Until the early 1930's all concrete pipe produced in the U.S. was non-reinforced. The oldest concrete pipe in the U.S. is a non-reinforced sewer line in Mohawk, New York. It was installed in 1842 and parts are still in use today.

Current ASTM standards for non-reinforced concrete pipe are listed below:

Table 1

STANDARD	SIZE RANGE	PUBLISHED
C 14	4" - 36"	1917
C 118	6" - 24"	1935
C 412	4" - 36" Drain Tile	1958
C 505	6" - 24" R/G Pressure Test 40 psi	1963
C 985	4" - 60"	1983

Currently approximately two thirds of the state departments of transportation use non-reinforced concrete pipe and include it in their specifications.

Non-reinforced concrete pipe is typically produced in sizes 12" - 36" in diameter, with sizes up to 60" being included in existing ASTM standards. For sizes larger than 36" handling steel is required. As a matter of information, 156" diameter non-reinforced pipe was produced for a special military project.

The design of non-reinforced concrete pipe includes a factor of safety of 1.5 which is equal to or greater than the specified test factor of safety for reinforced concrete pipe. The design strength verification is based on 3-edge bearing tests to the specified ultimate strength load requirement.

Such a test requirement assures the engineer/owner that, under service load conditions, the full structural integrity is maintained and that a 50% increase in load could occur without causing the pipe to crack.

Not only is a prudent design safety factor maintained, the handling safety factors are also very conservative, varying from 61 for 12" diameter to 9 for 36" diameter for standard B wall pipe (larger sizes have handling steel).

Installation procedures are the same as for reinforced concrete pipe. Such procedures and/or bedding factors are presented in AASHTO Standard Specifications for Highway Bridges, Section 17, ASCE Standard 15-93, and ACPA publication Design Data 40.

The installations in these documents, designated as Type I, Type II, Type III, and Type IV, reflect a broad range of typical bedding and compaction requirements.

Maximum fill heights as a function of pipe strength for these four installations are presented in Table 2:

Table 2

**D-LOAD vs. FILL HT.
TYPE I-IV INSTALLATIONS**

DESIGN D-LOAD	MAXIMUM FILL HT. (FT) INSTALLATION TYPE			
	I	II	III	IV
600	8	6	-	-
800	12	9	6	-
1000	16	12	8	6
1200	19	15	11	7
1350	22	17	12	9
1400	23	18	13	9
1600	26	20	15	11
1800	30	23	17	13
2000	34	26	19	15
2200	37	29	22	16
2400	41	31	24	18
2600	44	34	27	19
2800	48	37	29	21
3000	51	40	31	23

Notes:

1. The minimum required test D-load strength shall be 1.5 times the design D-load.
2. For fill heights less than 2.0', minimum design D-load shall be 1000D for 12" - 21" and 800D for 24" - 60".
3. Wall thickness may be varied to meet D-load requirements.