

design data 2



FRICTION FACTORS FOR CORRUGATED METAL PIPE

In 1958, a program of hydraulic model testing was initiated for determining roughness factors for structural plate corrugated metal pipe. These tests, authorized by the Office, Chief of Engineers, U. S. Army Engineers and performed under the co-sponsorship of the Office, Chief of Engineers and the Bureau of Public Roads, were conducted at the U. S. Army Engineer Waterways Experiment Station from April 1959 to September 1962.

Test results were presented at the 44th Annual Meeting of the Highway Research Board in January, 1965, and published in *Highway Research Record No. 116*. The paper is entitled: "Friction Factors for Hydraulic Design of Corrugated Metal Pipe", by John L. Grace, Jr., U. S. Army Engineer Waterways Experiment Station.

One of the important results of this research program is the accurate evaluation of Manning's n for the three commercially available corrugation patterns. *Figures 1 through 3*, reproduced from the research paper, show that Manning's n is higher than previously assumed and varies with the diameter of the pipe. *Table 1* presents the range of n values from each figure.

For many years the value of Manning's n for corrugated metal pipe was assumed to be 0.024. Little or no variation was made for the several corrugation patterns available. Based on research and experimental data, different

values of n are now being used for the various corrugation patterns. As currently available data is studied, the use of different values of n for the various corrugation patterns should become standard practice.

If flow conditions are such that hydraulic capacity is determined from Manning's formula, then *Table II* shows the decrease in hydraulic capacity of several pipe sizes based on an n value of 0.024 and an n value according to the accompanying figures. The percent decrease in design capacity, when based on the n values from the figures, is shown in the last column.

FIGURE 1: Manning's n Versus Pipe Diameter Standard Corrugated Pipe

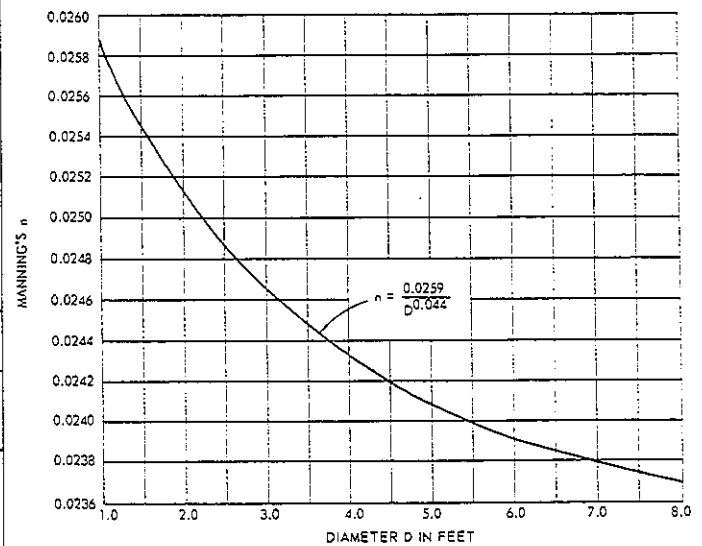


TABLE I:

Figure	Corrugation Pattern	Pipe Size Range	n Value Range
1	2 $\frac{2}{3}$ " x $\frac{1}{2}$ "	12" to 96"	0.0259 to 0.0237
2	3" x 1"	36" to 96"	0.0282 to 0.0262
3	6" x 2"	60" to 240"	0.0333 to 0.0298

TABLE II:

Pipe Size	Corrugation Pattern	Figure No.	Value of n From Figure	Percent Decrease in Design Capacity
12" D	2 $\frac{2}{3}$ " x $\frac{1}{2}$ "	1	0.02590	0.00190/0.02400 = 7.9%
36" D	2 $\frac{2}{3}$ " x $\frac{1}{2}$ "	1	0.02465	0.00065/0.02400 = 2.7%
36" D	3" x 1"	2	0.02820	0.00420/0.02400 = 17.5%
60" D	3" x 1"	2	0.02710	0.00310/0.02400 = 12.9%
72" D _n	6" x 2"	3	0.03350	0.00950/0.02400 = 39.6%
144" D _n	6" x 2"	3	0.03080	0.00680/0.02400 = 28.3%
72" D	6" x 2"	3	0.03280	0.00880/0.02400 = 36.7%
144" D	6" x 2"	3	0.03110	0.00710/0.02400 = 29.6%

FIGURE 2: Manning's n Versus Pipe Diameter 3" x 1" Corrugations

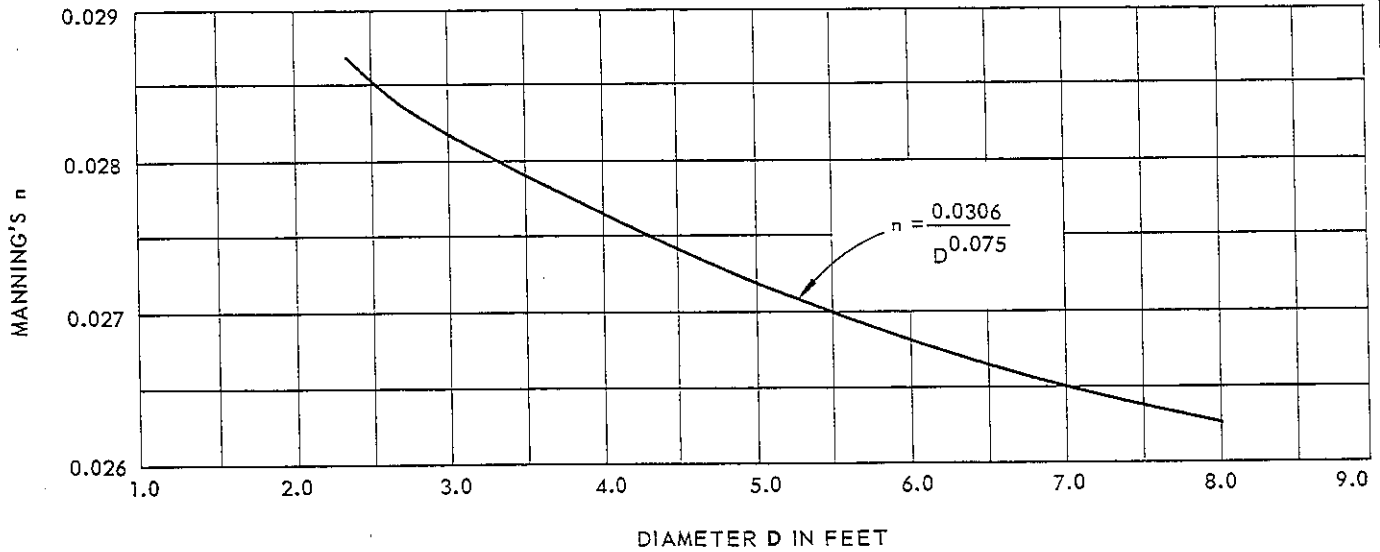


FIGURE 3: Manning's n Versus Pipe Diameter Structural Plate Pipe

