January 1989

Friction Factor Tests on 375 mm High Density Polyethylene Pipe

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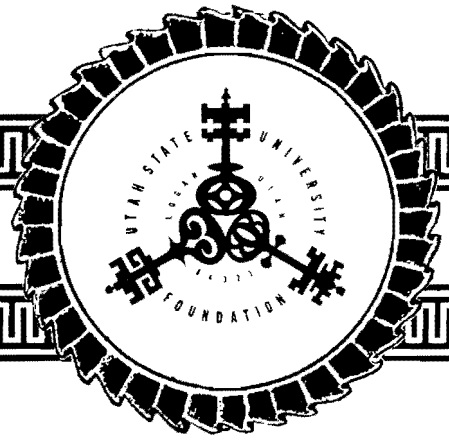

Utah State University Foundation

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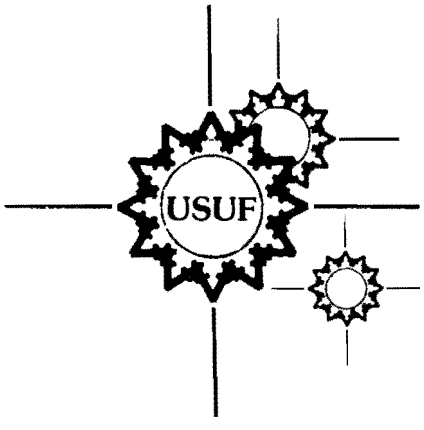

Hydraulic Report No. 223

FRICTION FACTOR TESTS ON 375mm HIGH DENSITY POLYETHYLENE PIPE

Submitted to:

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May 1989

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INTRODUCTION

Friction factor tests were conducted at the Utah Water Research Laboratory, Utah State University Foundation on a 375mm diameter high-density, polyethylene, Boss N-12 pipe manufactured by Big "O", Inc. The interior surface of the pipe was relatively smooth in texture and corrugation. However, there was a slight roughness at the corrugations caused by the overlapping of the interior seams. The seams themselves were readily visible. The shape of the corrugations was mildly sinusoidal with an overall depth of approximately 1.5mm.

The pipe was furnished in 6.08m lengths. The joints were sealed with a CANUSA heat shrink wrap and an epoxy filler which plugged the spiral corrugations. The heat shrink wrap was also used to connect the HDPE pipe to the steel pipe in the laboratory. Tests were conducted for full pipe flow at velocities between 0.6 and 3.5m per second.

FACILITIES AND PROCEDURE

Figure 1 shows the installation of the test pipe. Water was supplied through a 1200mm pipeline by gravity flow from a small reservoir; the pipe tapered off to 450mm upstream from the test section. To establish a fully developed flow upstream from the test section, one length of HDPE pipe was installed downstream from the 450mm laboratory steel pipe. The length between pressure taps for the test section was 23.16m (see Figure 1).

Pressure was controlled using a 1200mm butterfly valve which was installed in the main supply line. The flow was controlled and the pipe kept full by using a 400mm butterfly valve which was located downstream from the last test section. To prevent rupture of the CANUSA wrap, it was necessary to limit the pressure head in the pipe to approximately 4m.

Flow was measured with a sonic meter which was calibrated with weight and volumetric tanks at the laboratory. To ensure accuracy, the tanks had been calibrated traceable to the U.S. Bureau of Standards. Thus, the accuracy of the sonic meter was plus or minus one percent.

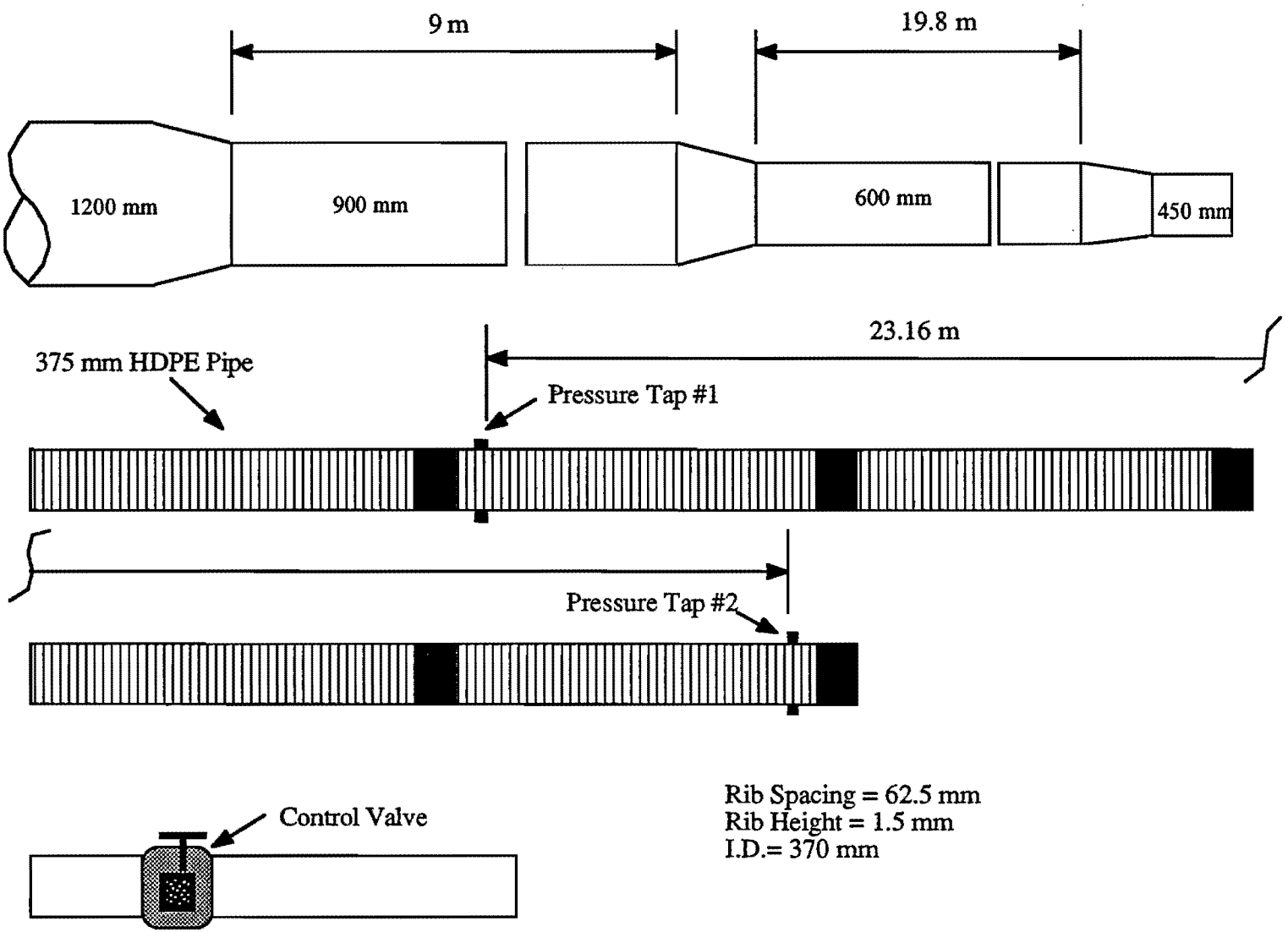
The meter provided a digital readout of the flow in cubic feet per second. To obtain the average flow rate, a minimum of 30 samples, taken over a 60 second time period, were recorded from the digital readout device and averaged. Friction-loss in the pipe for each flow rate was measured with a differential manometer. The differential manometer contained a blue Merian manometer fluid (specific gravity 1.75).

As the flow rates and their corresponding friction losses were measured, the data were immediately computer processed to check the results before flow conditions were changed.

RESULTS

Experimental results from the three sets of tests are contained in Table 1 and Figures 2-3. Plots are provided of the variation of the Darcy-Weisbach friction factor f versus velocity and the Manning's n versus velocity. (To calculate the average velocity, the diameter of the pipe was consistently measured at the corrugation peaks, and the flow ran in the same direction as the seams to reduce friction.)

Note that the Manning's n varies from 0.0108 to 0.0099, corresponding to a velocity variation of 0.7 to 3.4m per second. Additionally, the friction factors decrease slightly with increased velocity.



375 mm HDPE Pipe Setup

Figure 1

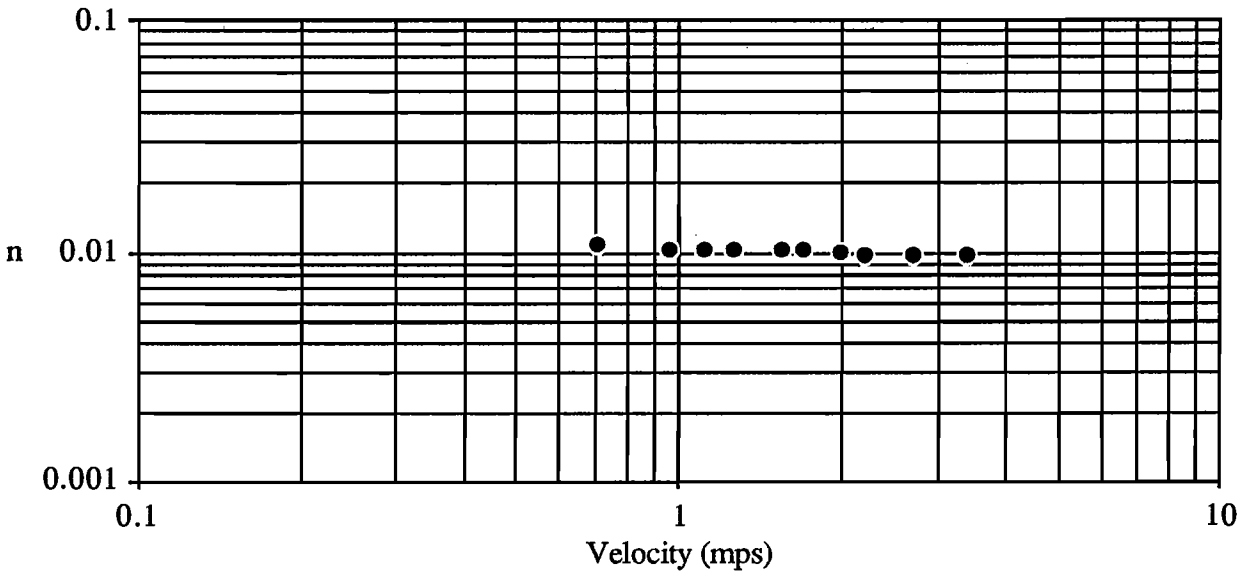
TABLE 1
Test Data for Friction Test on 375mm Plastic Pipe

Utah Water Research Laboratory
Data Sheet for Friction Loss Test

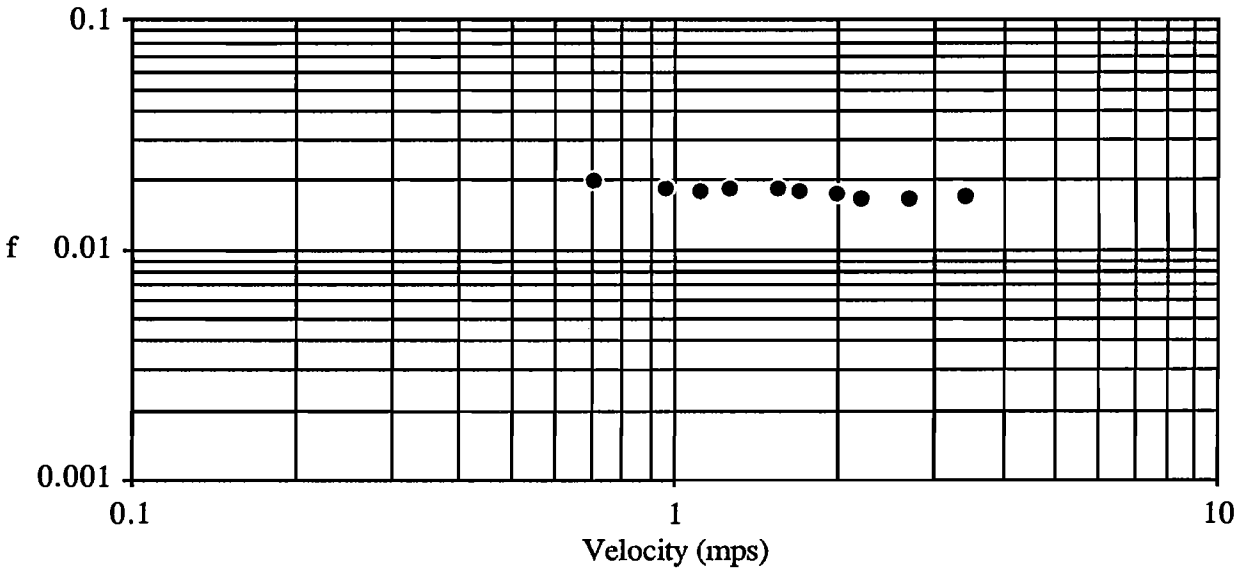
BIG "O"
PIPE: 375 mm HDPE
Date: March/28/1989
Tested by: Steven L. Barfuss
Kelvin Anderson

Pipe Dia.= 14.80 in. = 370mm
Area = 1.19 ft sq = 1075cm sq
Length = 77.2 ft. = 23.16m

Run No.	Sonic Q ave. Meter	Diff LEFT cm.	Mano RIGHT cm.	Mano Conv to m	DP Meter	Actual Q cms	V MPS	Darcy f	Manning's n
1	13.87	46.60	36.20	0.00750	0.62	0.38	3.40	0.01680	0.0099
2	11.03	31.10	20.50	0.00750	0.39	0.30	2.70	0.01669	0.0098
3	9.03	22.50	11.70	0.00750	0.26	0.24	2.20	0.01665	0.0098
4	8.18	20.10	9.10	0.00750	0.22	0.22	1.99	0.01741	0.0100
5	7.01	16.40	5.60	0.00750	0.16	0.19	1.69	0.01803	0.0102
6	6.39	14.60	3.80	0.00750	0.14	0.17	1.54	0.01826	0.0103
7	5.26	11.60	0.70	0.00750	0.09	0.14	1.26	0.01829	0.0103
8	4.66	10.10	-0.70	0.00750	0.07	0.12	1.11	0.01801	0.0102
9	4.05	9.00	-1.90	0.00750	0.05	0.11	0.96	0.01827	0.0103
10	3.06	7.55	-3.30	0.00750	0.03	0.08	0.71	0.01988	0.0107
							ave.=	0.01783	0.01016



Manning n vs. Velocity for 375mm Diameter HDPE Pipe
Figure 2



Friction f vs. Velocity for 375mm Diameter HDPE Pipe
Figure 3