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Friction Factor Tests on 300 mm High Density Polyethylene Pipe

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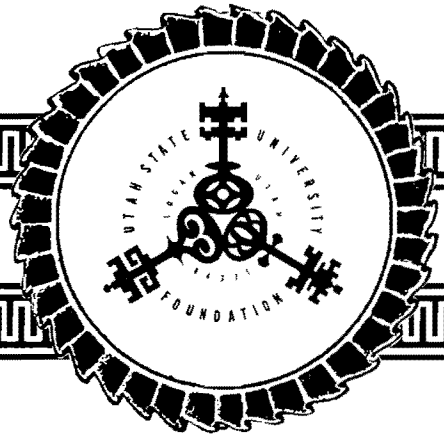

Utah State University Foundation

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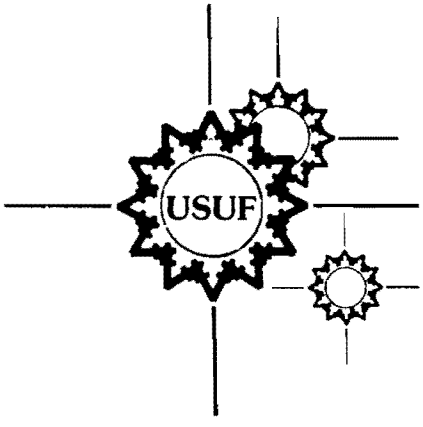

Hydraulic Report No. 224

FRICTION FACTOR TESTS ON 300mm HIGH DENSITY POLYETHYLENE PIPE

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INTRODUCTION

Friction factor tests were conducted at the Utah Water Research Laboratory, Utah State University Foundation on a 300mm diameter, high-density, polyethylene, Boss N-12 pipe manufactured by Big "O", Inc. The interior surface of the pipe was smooth in texture and corrugation, although there was some waviness at the corrugation peaks. The shape of the corrugations was mildly sinusoidal with an overall depth of approximately 1.2mm.

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 23.1m (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 300mm 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 of the measurements, the tanks were calibrated traceable to the U.S. Bureau of Standards. Thus, the accuracy of the sonic meter was plus or minus one percent.

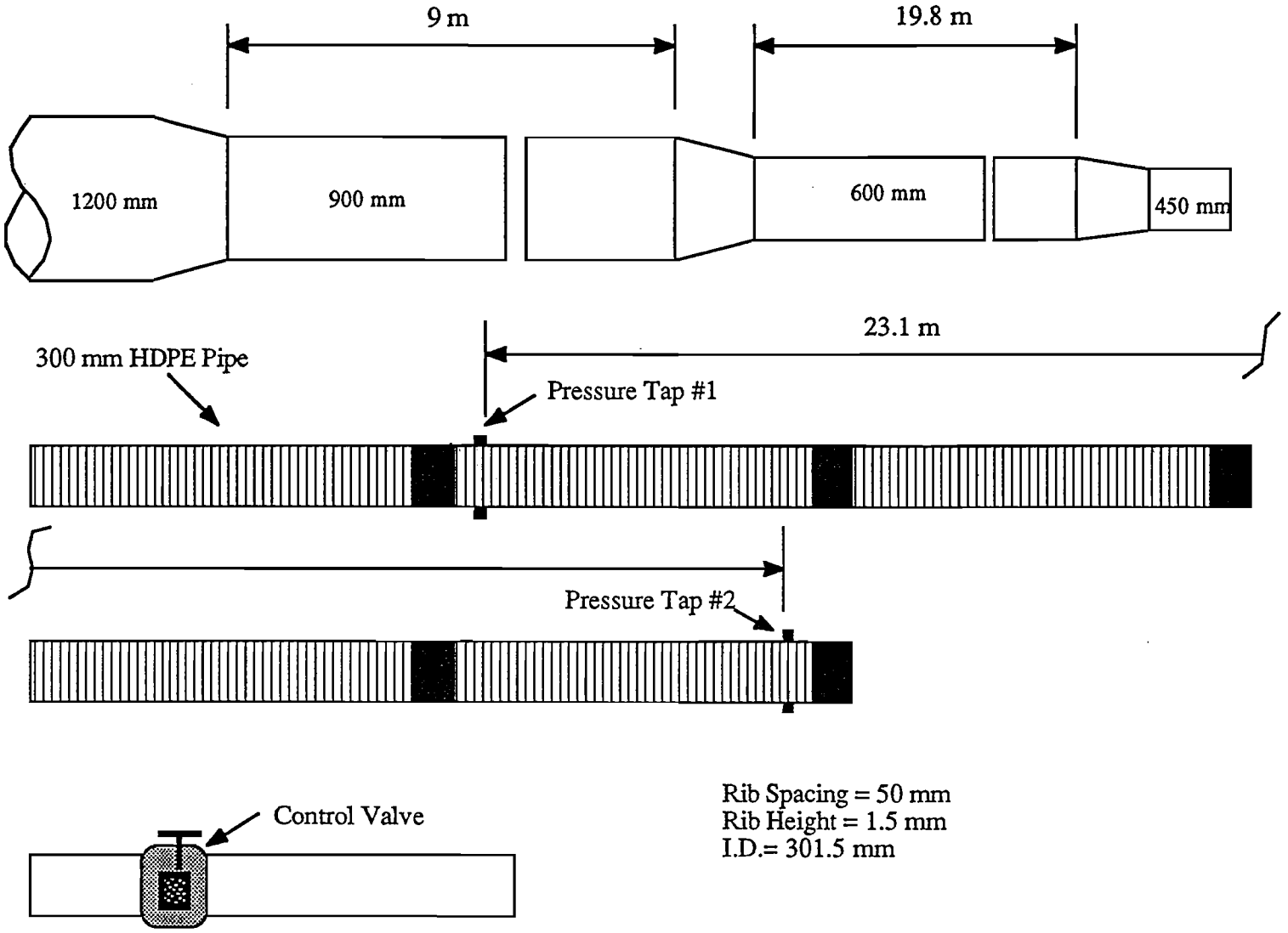
The meter provided a digital readout of the flow in cubic feet per second. To obtain the average flow rate, a minimum of 30 samples, taken over a 60 second time period, were recorded from the digital readout device and averaged.

The friction-loss in the pipe was measured for each flow rate 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 for 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.)

Note that the Manning's n varies from 0.0090 to 0.0083 corresponding to a velocity variation of 1.0 to 3.0m per second. Additionally, the friction factors decrease slightly with increased velocity.



300 mm HDPE Pipe Setup

Figure 1

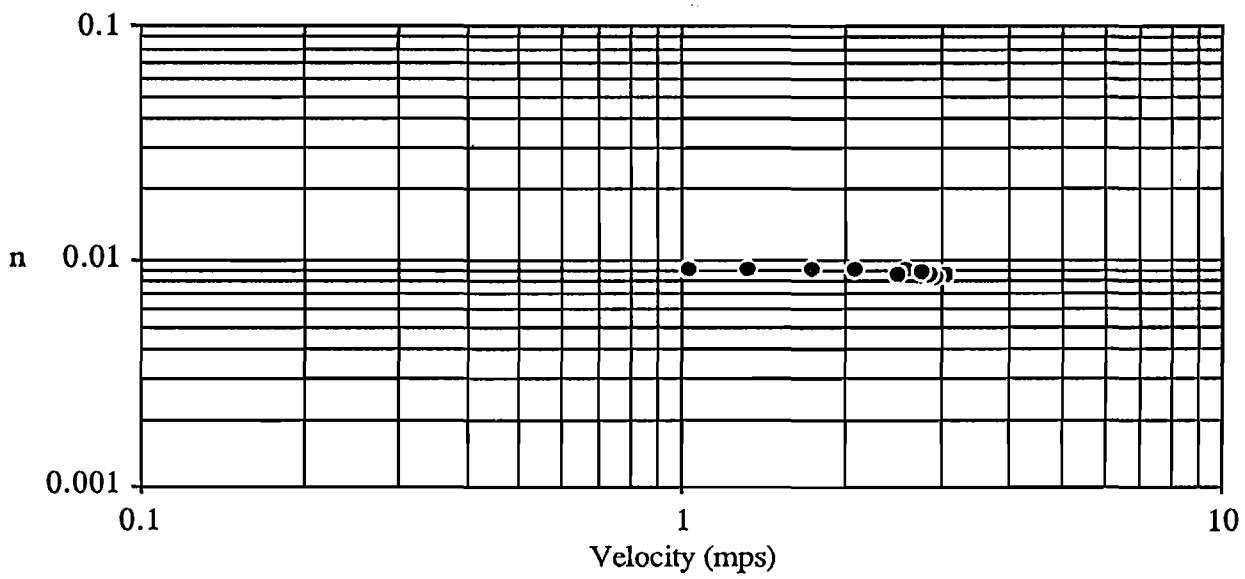
TABLE 1
Test Data for Friction Test on 300mm Plastic Pipe

Utah Water Research Laboratory
Data Sheet for Friction Loss Test

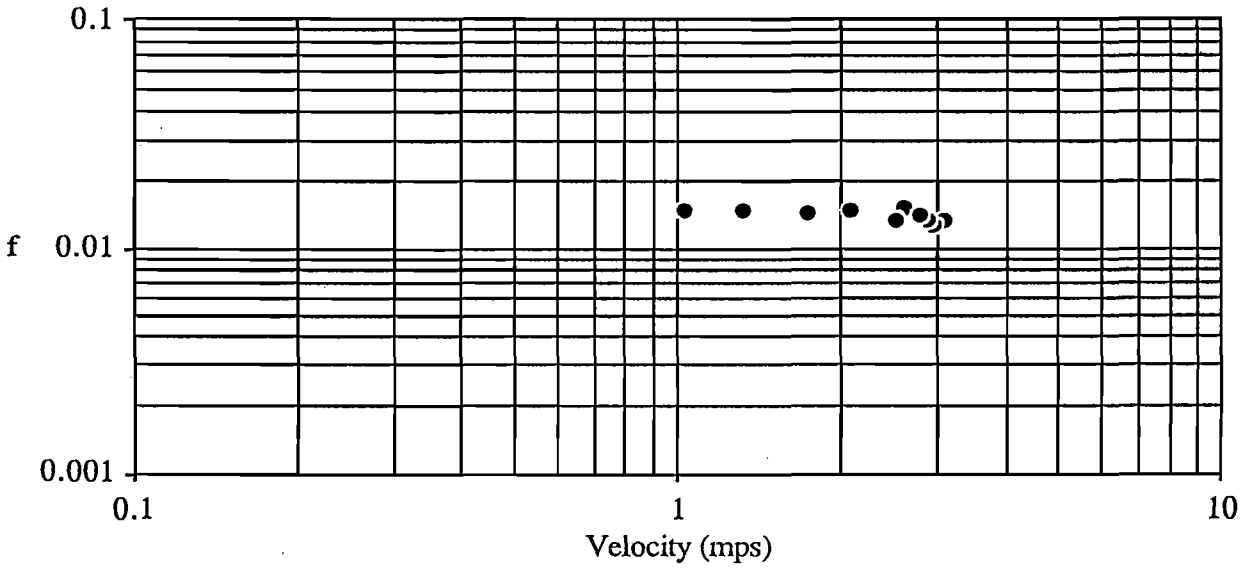
BIG "O"
PIPE: 300 mm HDPE
Date: March/30/1989
Tested by: Steven L. Barfuss
Kelvin Anderson

Pipe Dia.= 12.06 in. = 301.5mm
Area = 0.79 ft sq = 713.9cm sq
Length = 77.0 ft. = 23.1m

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	8.41	38.8	27.8	0.0075	0.50	0.23	3.08	0.01351	0.0086
2	8.03	33.80	23.50	0.0075	0.43	0.22	2.93	0.01279	0.0083
3	7.13	31.50	21.60	0.0075	0.40	0.19	2.60	0.01514	0.0090
4	7.86	34.20	23.40	0.0075	0.43	0.21	2.87	0.01343	0.0085
5	7.60	33.30	22.60	0.0075	0.42	0.20	2.77	0.01397	0.0087
6	6.88	27.60	16.55	0.0075	0.33	0.18	2.50	0.01355	0.0086
7	5.75	22.20	10.95	0.0075	0.25	0.15	2.08	0.01475	0.0089
8	4.81	17.10	5.65	0.0075	0.17	0.13	1.72	0.01469	0.0089
9	3.73	12.55	1.10	0.0075	0.10	0.10	1.32	0.01507	0.0090
10	2.95	10.00	-1.90	0.0075	0.06	0.08	1.03	0.01477	0.0089
							ave.=	0.01417	0.00875



Manning n vs. Velocity for 300mm Diameter HDPE Pipe
Figure 2



Friction f vs. Velocity for 300mm Diameter HDPE Pipe
Figure 3