

CHAPTER 6

FLOW-MEASURING DEVICES

6-1. General considerations. Flow-measuring devices are required for all wastewater treatment plants of the types to measure various influent, effluent, and in-process wastewater flows. Equipment for indicating, totalizing, and recording the effluent wastewater flow will be provided for all secondary-treatment plants with flows greater than 0.10 mgd and smaller plants in special cases. For plants less than 0.10 mgd, recording and totalizing equipment will be provided as required to assure effluent limitation within regulations imposed by the regulating authority. In plants requiring recirculation of wastewater, meters with means for indicating the rates of recirculation are required. Weirs, Parshall flumes, and magnetic flow meters are satisfactory for measuring wastewater flow, Parshall flumes being generally preferable for Army projects when measuring influent or effluent. Measuring devices will be designed, or specified, with a view toward obtaining the accuracy of measurement throughout the expected range of flow. Principles of design of such devices are covered in standard handbooks.

6-2. Types of flow-measuring devices. The following paragraphs describe the types that are suitable for use in wastewater treatment plants. For additional comments refer to table 6-1.

a. Weirs. Weirs shall be located in a channel so that the flow will not be disturbed by turbulence and in such a manner that the depth of flow over the weir can be observed and recorded. When continuous recording is required, the float will be installed in a chamber separated from the main channel of flow, but connected thereto by piping.

b. Parshall flumes. A typical Parshall flume is shown in figure 6-1. This device has many advantages: the loss of head is minimal; it is self-cleaning; flow measurement can be made in open-channel flow; and it has no moving parts to malfunction. The downstream water-surface elevation above the flume approach floor, a, must not exceed 65 percent of water elevation, b, upstream of the flume. The flume will be designed with the narrowest throat practicable for the conditions under consideration. The stilling well shown in figure 6-1 provides a quiescent zone in which to measure the height, h. Flow through a Parshall flume, with a throat width of at least 1 foot but less than 8 feet under free flow conditions, may be estimated by the following formula:

$$Q = 4Bh^{1.522B^{0.026}}$$

Table 6-1. Types of Measuring Devices Applicable to Wastewater Treatment

Primary Measurement and Type of Device	Use	Limitations	
		General	Capacity Range
<u>Flow</u>			
Open channels:			
Head area meters -			
Flume ¹	Plant influent, bypass lines	More costly than weir	13 gpm to 3,000 mgd
Weir ²	Primary effluent, plant effluent	Produces greater head loss than flume	Virtually unlimited
Velocity meters -			
Propeller	Clean liquids up to 2 percent solids	Requires fixed cross-sectional area. Low head loss	30 gpm to virtually unlimited, 0.9 to 20 fps
Pressure pipelines:			
Differential producers			
<u>Level</u>			
Staff gage	Wet wells, floating cover digester	Use for indication only. Location must be visible	Unlimited 100 to 1
Float	Wet wells	Indication near tank	Unlimited 100 to 1
Probes	Wet wells	Do not use for indication. Fluid must be electrolyte	Unlimited 100 to 1

¹Suspended matter does not hinder operation.

²Normally requires free fall for discharge.

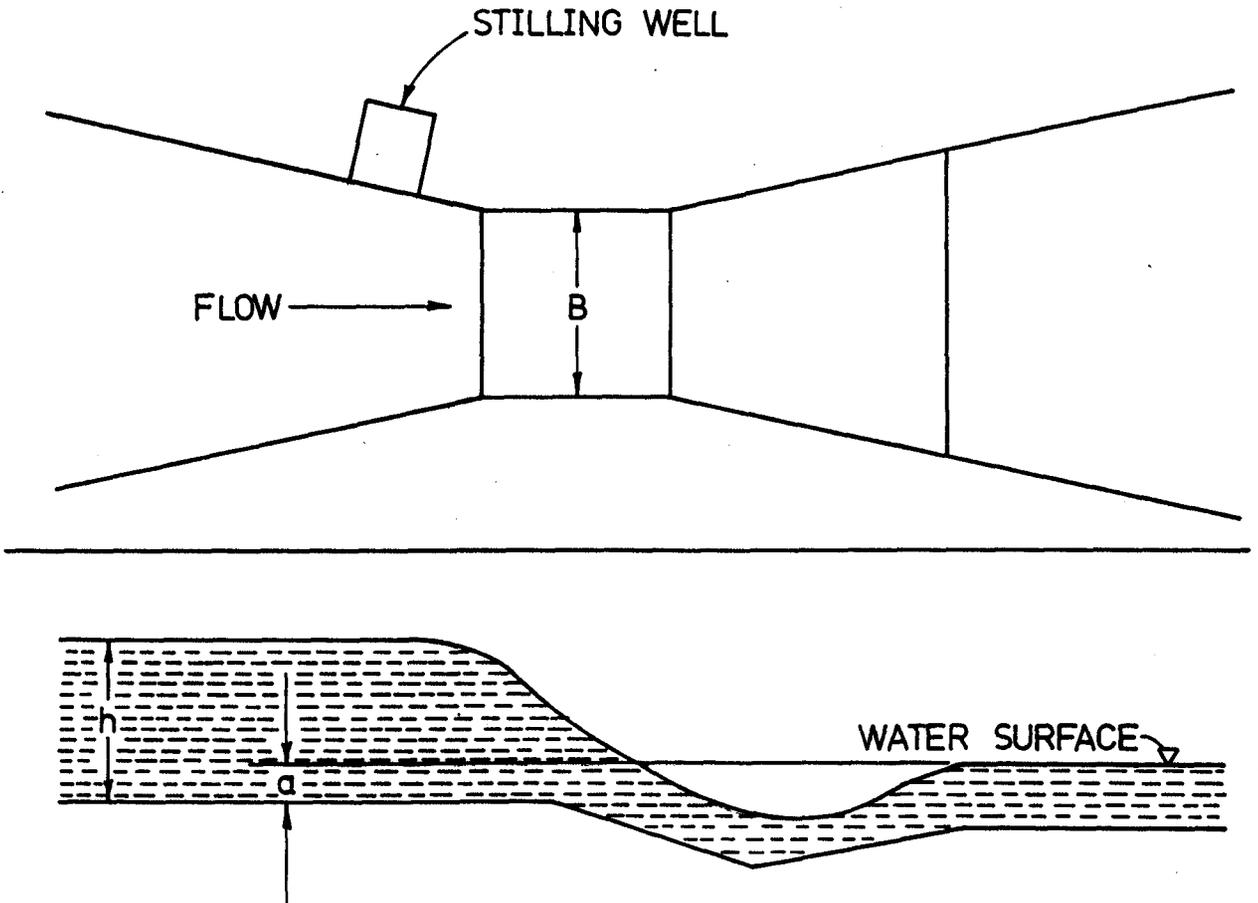


FIGURE 6-1. PARSHALL MEASURING FLUME

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where:

Q = flow, cfs

B = throat width, feet

h = upper head, feet

A tabulation of this formula is given in table 6-2.

Table 6-2. Parshal Flume Flow Values
(cfs)

Upper Head, h (feet)	Throat width, B (feet)							
	1	2	3	4	5	6	7	8
0.1	.12	.23	.33	.42	.52	.61	.70	.79
0.2	.35	.66	.96	1.26	1.56	1.84	2.13	2.41
0.3	.64	1.24	1.82	2.39	2.96	3.52	4.07	4.63
0.4	.99	1.93	2.86	3.77	4.67	5.57	6.46	7.34
0.5	1.39	2.73	4.05	5.36	6.66	7.95	9.23	10.5
0.6	1.84	3.62	5.39	7.15	8.89	10.6	12.4	14.1
0.7	2.32	4.60	6.86	9.11	11.4	13.6	15.8	18.0
0.8	2.85	5.66	8.46	11.3	14.0	16.8	19.6	22.4
0.9	3.41	6.79	10.2	13.5	16.9	20.3	23.7	27.0
1.0	4.00	8.00	12.0	16.0	20.0	24.0	28.0	32.0
1.1	4.62	9.27	13.9	18.6	23.3	27.9	32.6	37.3
1.2	5.28	10.6	16.0	21.3	26.7	32.1	37.5	42.9
1.3	5.96	12.0	18.1	24.2	30.3	36.5	42.6	48.8
1.4	6.68	13.5	20.3	27.2	34.1	41.0	48.0	55
1.5	7.41	15.0	22.6	30.3	38.1	45.8	54	61
1.6	8.18	16.6	25.1	33.6	42.2	51	59	68
1.7	8.97	18.2	27.5	37.0	46.4	56	65	75
1.8	9.79	19.9	30.1	40.4	51	61	72	82
1.9	10.6	21.6	32.8	44.1	55	67	78	90
2.0	11.5	23.4	35.5	47.8	60	72	85	97

c. Magnetic flow meters. Magnetic flow meters can be used for flow measurement in wastewater treatment plants. There are many types of magnetic flow meters, however, and direct contact with the manufacturers is the quickest and generally most practical way to determine their application to specific wastewater measurements.