Parshall Flume Installation to Insure Free-Flow (In an Existing Canal)

In most cases it is preferable to have a Parshall flume operate under free-flow conditions. The principal advantage is that only the upstream flow depth, H_a, need be measured to determine discharge. Another advantage, if a continuous recorder is to be used, is the expense involved in purchasing a recorder that only measures on flow depth (H_a) rather than two (H_a and H_b) that would be required if the flume were submerged. The procedure for installing a Parshall flume in a canal to insure free-flow is listed below.

1. Establish the maximum flow rate to be measured.
2. Locate the high water line on the canal bank where the flume is to be installed and determine the maximum depth of flow.
3. Select from the free-flow discharge tables, the proper depth of water, Ha, corresponding with the maximum discharge capacity of the canal. For example, assuming that a 2-foot flume is to be used and the maximum discharge is 27.0 second-feet, the depth of water, H_a, on the crest is 2.19 feet.
4. Place the floor of the flume at the depth which does not exceed the transition submergence multiplied by H_a (S_t x H_a) below the high water line (Figure 1). In general, the floor of the flume should be placed as high in the canal as grade and other conditions permit.

As an example, a 2-foot Parshall flume is shown in Figure 1. The transition submergence for the 2-foot flume is 66 percent. The maximum discharge in the canal is 27.0 CFS, which for free-flow conditions has an H_a value equal to 2.19 feet (from the discharge table). Multiplying Ha (2.19 feet) by the transition submergence (0.66), gives a depth to flume floor of 1.45 feet (2.19 feet x 0.66 = 1.45 feet). Therefore, the flume crest should be set no lower than 1.45 feet below the original maximum water surface (Figure 1). The loss of head through the structure will be the difference between 2.19 feet and 1.45 feet, which is 0.74 feet as shown in Figure 1. If the amount of head loss is too great, then a larger flume could be used with a resulting decrease in the head loss.
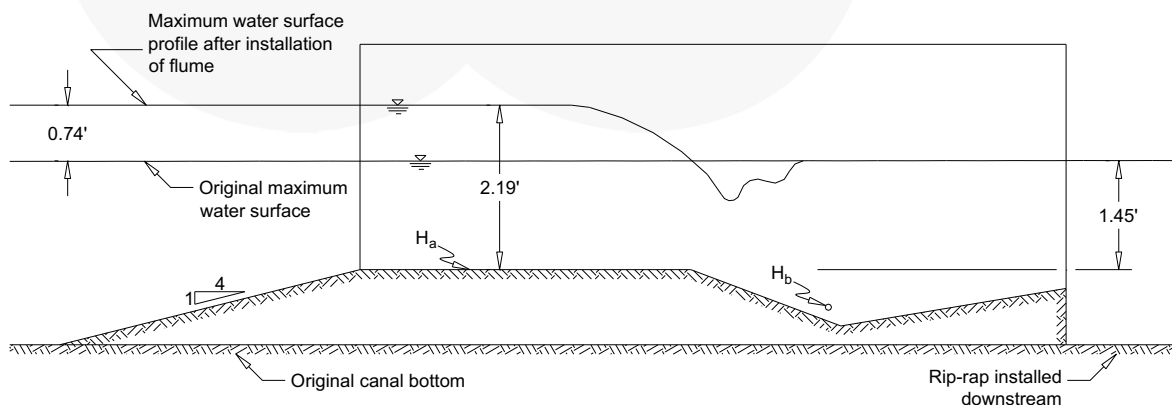

Figure 1: Installation of 2-foot Parshall Flume to operate under free-flow conditions

Source:

Skogerboe, Hyatt, England, and Johnson. 1967. Design and Calibration of Submerged Open Channel Flow Measurement Structures, Part 2: Parshall Flumes, Report WG31-3, Utah Water Research Laboratory, College of Engineering, Utah State University, Logan, UT. March.