Cippoletti Weirs. Some weirs are constructed so that the sides of the notch slope out from the weir crest at the rate of 1 to 4. These weirs, called Cippoletti weirs (Figure 5), discharge through the triangular portions at the ends of the weir the same amount the discharge per unit of head is decreased because of end contractions.

This permits the use of the equation

$$Q = 3.67Lh^{3/2} \tag{8}$$

with all terms as previously defined.

In the field, weirs can easily measure flows accurately (within 15%); however, there are some precautions and limitations to their use. Silt and sediment deposition behind a weir increases the flow rate for a given head. A weir also requires a difference in elevation between the upstream water level and downstream water level, which may be difficult to attain for channels having very little slope. When the water level on the downstream side of a weir becomes high enough so that water does not spill freely over the weir, then the weir is submerged and equations (5) to (8) are no longer valid.

Orifices

Open-channel Orifices. An orifice for measuring flow rates in an open channel usually consists of either a round or a rectangular opening in an obstruction placed across the channel. The edges of the opening are usually sharp and constructed of metal. The size of the opening is small compared to the area of the stream, therefore water backs up on the upstream side of the obstruction. The orifice equation is

$$Q = 0.61\, a\, (2gh)^{1/2} \tag{9}$$

where a is the cross-sectional area of the opening (ft^2),

g is the acceleration of gravity (32.2 ft/sec^2), and

all other terms are as previously defined.

This equation may be written

$$Q = 4.89\, ah^{1/2} \tag{10}$$

since $2g = 8.02$. The head is measured as shown in Figures 9 and 10. The first illustration (Figure 9) is of free-flow conditions, when the downstream water level is below the orifice. The second illustration (Figure 10) is of submerged conditions, when the downstream water level is above the orifice and both the upstream and downstream water elevations must be accurately measured. The difference in the water elevations is the head, h, for the submerged condition. Conditions where the downstream water level submerges only part of the orifice should be avoided. The orifice then acts like a submerged weir.