3.3.2. Prefabricated structures

Prefabricated structures for earthen channels need to be constructed in such a way that flow does not pass under or around the structure. Several methods can be used to provide appropriate cutoff walls. For weirs constructed from sheet metal, the throat and converging transition are attached together as one unit, including floors and walls. The approach section, diverging transition, and tailwater channel are optional. Wooden sheet piling can be driven into the ground to provide an appropriate cutoff wall, as was shown in Figure 3.27. The opening in the cutoff wall should approximately fit the shape of the prefabricated weir. The weir is then attached to the cutoff wall in the area of the throat. A seal must be provided between the weir and cutoff walls to avoid leakage. Downstream from the structure, rock or stone should be placed to avoid erosion of soil and subsequent undercutting of the structure. If the wall gage is placed in the unlined approach channel, special care must be taken to assure that the gage does not settle after it has been set to the proper elevation. This may require a stiff member (wood, steel, etc.) to be well anchored into the ground. This staff should be placed so that it does not catch floating debris and so that it can be reached from the canal bank for cleaning (see Figure 4.10).

Another style of prefabricated weir for an unlined channel is shown in Figure 3.37. Here, a section of concrete pipe is used as a section of channel in which the weir is constructed. The pipe essentially provides the surfaces for the approach and tailwater channels and the sides for the throat and transition sections. Trenches are dug for the cutoff walls and are cast in place, as shown in Figure 3.38. The pipe section is then lifted into place while the concrete for the cutoff walls is still wet. Here, care needs to be taken to assure that the throat is level in the direction of flow, and that the pipe section is rotated to the correct position so that the weir is level transverse to the flow.
A wall gage can be mounted on the side of the pipe wall; however, this would make it difficult to read unless a hole was cut into the pipe. Often a stilling well is placed on the outside of the pipe section (Figure 3.38). A hole is cut in both the pipe and the stilling well so that a pipe can be used to connect them. Care should be taken to assure that the stilling well does not settle. Soil should be backfilled around the cutoff walls, the stilling well, and pipe section to assure that everything remains in place. Downstream from the structure, rock or stone should be placed to avoid erosion of soil and subsequent undercutting of the structure.

Prefabricated weirs installed in smaller pipe sections can be used as portable measurement devices. (e.g., see Figure 4.26)

3.3.3 Portable and temporary structures

Trapezoidal-shaped control

Five portable RBC flumes (Clemmens et al. 1984) were designed for use in furrows and small earthen channels (Figure 3.39). These flumes are scale models of each other in which the width of the sill crest $b_r$ varies from 50 to 200 mm. Because all other flume dimensions are proportional to $b_r$, each structure has a different overlapping flow range. For sizes of $b_r$ and the related throat length and flow ranges, see Table 5.5.

To facilitate construction, the shape of the flume is kept relatively simple. As a result, it can be constructed from most sheet materials. Commonly, 1-mm thick galvanized sheet metal is used. The construction drawings are given in Figure 3.40. All dimensions are related to the throat width, $b_c$. 

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Figure 3.37: Prefabricated weir constructed in a section of concrete pipe (California).
Figure 3.38 The pipe section is set into place while the concrete for the cutoff walls is still wet.

Figure 3.39 Portable RBC flumes are very suitable for flow survey work (Arizona).
Figure 3.40: Construction drawings for portable RBC flumes. Dimensions are given in terms of $h_c$, so that the drawing applies to all five flume sizes.

**NONFOLDED SHEETS**

**NONFOLDED BOTTOM SHEET**
- Bend down about 20°
- Break up 63.4°
- Break down 90°

**NONFOLDED WEIR SHEET**
- Bevel edge to fit 1 to 2 slope
- Break down 18.3°

**NONFOLDED CUT-OFF SHEET** (2 times)
- Adjust to fit selected channel top frame
- Break down 90°
- Break down 90°
The head $h_i$ is measured in a translocated stilling well. The stilling well is mounted near the control section to minimize changes in the sill reference of the well caused by a slightly non-level installation. Cross-slope leveling of the flume is facilitated by keeping the upstream edge of the cutoff parallel to the water surface. Leveling of the longitudinal slope may be done by use of a carpenter’s level. Experienced users can soon judge adequate leveling and will not require a carpenter’s level. If the portable RBC flume is installed for seasonal or semi-permanent flow measurement, we advise using the alternative stilling-well location on the side of the flume (Figure 3.41). Otherwise, the unattended tube would collect floating debris. This location is also recommended on the two smallest ($b_c = 50$ mm or $75$ mm) flumes because it allows the use of a larger-diameter stilling-well tube. If the alternate (side mounted) stilling-well location is used, the stilling well should be located at a distance of $1.5b_c$ upstream from the downstream end of the flume.

A suitable sequence to assemble the RBC flume is as follows:

- Fasten the cutoff sheets to the bottom sheet. The easiest method is to rivet them in place by using four metal strips bent $90^\circ$, and then make watertight joints with silicone sealer.
- Adjust back-face of sill to fit accurately and pop rivet into place. Be sure to drill holes to fasten pipe clamp before riveting.
- Glue weir sill into place with silicone gel. Note that side edges of sill plate must be beveled so that sill width equals the desired $b_c$ value.
- Pop rivet or bolt channel top frames to folded edge of cutoff sheets.

Figure 3.41  Portable RBC flumes with standard and alternative stilling-well locations. These flumes have a 109-mm throat bottom width.
• Insert length of copper tubing through perforated rubber plug, and glue this plug into stilling-well tube.
• Mount the stilling-well tube. Adjust the tube so that the top of the rubber plug coincides with the crest of the sill, and fasten pipe clamps.
• Now, solder or glue the length of copper pipe at the hole where it passes through the side-wall of the flume.
• Solder a short 90° bent length of copper tubing into the pressure-tap hole. The end of the tubing should be flush with the surface of the side-wall sheet. This pressure tap hole must be perpendicular to the flume side wall to avoid a systematic error in the head measurement (see Figure 4.13).
• Connect the above two lengths of stilling-well tubing with transparent plastic tubing. The tubing must slope down along the bottom sheet and up to the bottom of the stilling well. No upward intermediate bends may exist in this tubing because they will trap air and thus cause errors in the head reading.

Commercial versions of the RBC flumes are available in both stainless steel and fiberglass. (Figure 3.42). The use of an RBC flume with the dipstick method of measurement (See Sections 4.3, 4.6 and 4.10) is shown in Figure 3.43.

Figure 3.42. Commercially available RBC flume constructed from fiberglass.
Rectangular-shaped control

Because the bottom width of a rectangle is wider than a trapezoid having the same area, a portable weir with rectangular control section can have a relatively large capacity. Rectangular flumes like those discussed in Section 3.3.1 can be constructed from fiberglass, wood, or sheet metal and used as a portable structure (Figure 3.44—wooden flume, Figure 3.45—sheet metal flume). At least one size is available commercially in fiberglass (Figure 3.46). A sheet of canvas, plastic or other suitable material is attached near the upstream end of the flume. This sheet is attached to the flume so that no water can leak between the flume and the sheet. A shovel is used to excavate soil and the cutoff sheet is then buried to assure that no water flows around or under the structure. The depth to bury this cutoff sheet depends on the soil, but 0.1 m (4 in.) is often sufficient. These structures can be placed on the soil and leveled, or rods can be driven into the ground to stabilize the structure. These rods slide through collars that are rigidly attached to the flume (Figure 3.47). A locking screw that holds the collar to the rod is used to hold the flume in place vertically.

These flumes can easily be placed in a dry channel, but it is difficult to judge the proper elevation at which to set them. Placement of these flumes in flowing water is possible, but adjustment of flume elevation can be difficult due to the weight of the water. The Adjust-A-Flume was developed to avoid the difficulty in adjusting the elevation of the flume while in flowing water (Figure 3.48). The device consists of two rectangular
metal boxes that are adjustable with respect to each other (Figure 3.49). The outer section remains fixed once set in the channel. The throat section can be easily raised to the proper elevation so that the flow is not overly submerged and so that the drop through the flume is not excessive. These flumes avoid most of the difficulties associated with the use of portable flumes in earthen channels.

Figure 3.44 Portable rectangular-throated flume constructed of wood (Egypt)

Figure 3.45 Portable rectangular-throated metal flume.
Figure 3.46 Commercially available portable rectangular-throated flume constructed from fiberglass.

Figure 3.47 The fiberglass rectangular flume is leveled by sliding the flume vertically along the rods and then locking in place.
Figure 3.48  Commercial version of adjustable-sill flume (Adjust-A-Flume, Na-way Flume and Equipment Co., P.O. Box 814, Delta CO 81416 USA). (Trade and company names are shown for the benefit of the reader and do not imply endorsement or preferential treatment of the company or product listed).

Figure 3.49  General layout for Adjust-A-Flumes with capacity up to 170 liters/s. (305 mm width shown has capacity of 57 liters/s. All dimensions are in mm).