15.4 Outlets and Modules

The success of any irrigation enterprise depends on the efficiency of distributing sufficient supply of water to the irrigator. Each irrigator has to receive certain quantity of water proportionate to his extent in a canal system at the proper time to ensure him a good crop. This distribution of water is carried out by means of outlets otherwise called modules. Hence, proper design of an outlet, is of most importance not only to the canal engineer but to the irrigator also.

In Punjab and Maharashtra, a number of outlet structures were evolved, designed to allow into the cultivator's watercourses a constant discharge irrespective of the supply (level) in the distributing channel (module) or discharges proportional to the supply (level) in the channel (semi-module). A few of the structures in common use in India are

(i) Standing wave flume.

(ii) Crump's adjustable proportional Semi module.

(iii) Lindley type standing wave flume.

(iv) Orifice type standing wave pipe outlet.

(v) Gibb's module.

There are various types of modules:

a. Rigid Modules

These modules allow constant discharge within reasonable working limits of head irrespective of water levels in the distributory and the water course of the main canal.

b. Flexible Modules or Semi Modules

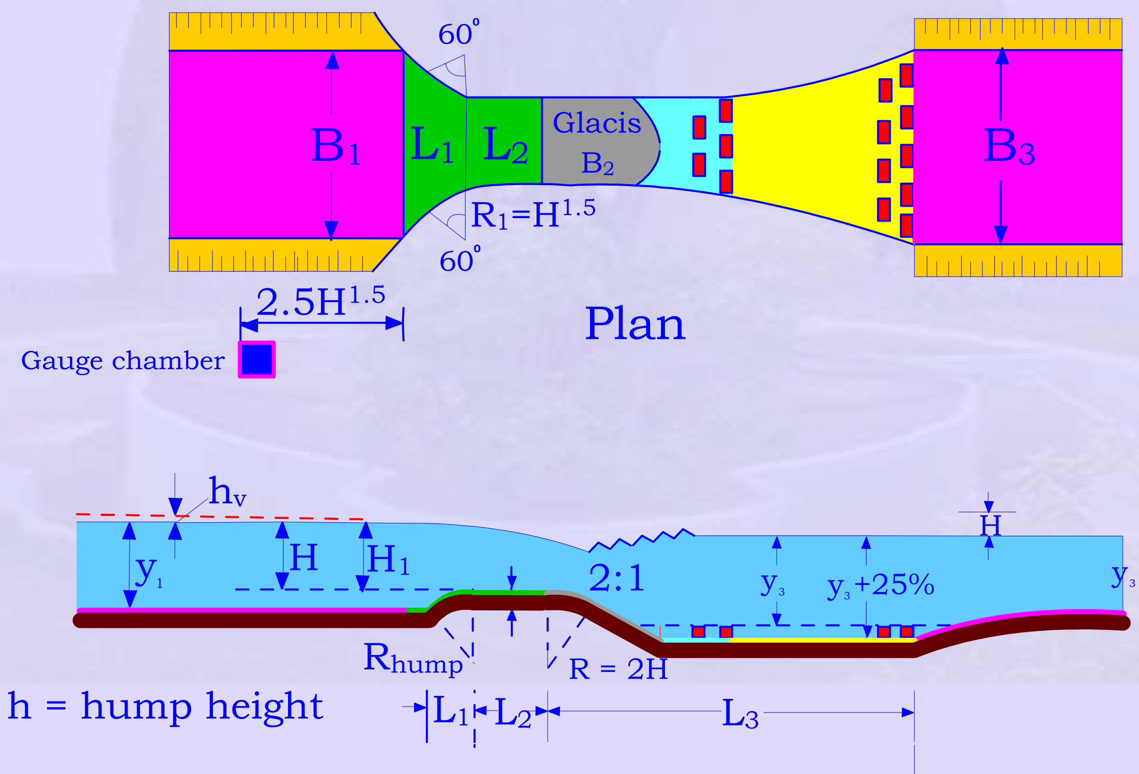
This type of module gives discharge in some characteristic manner with surface level in the supply channel but independent of the variation of the water level in the delivery channel.

c. Non-Modular Outlets

Non-modular outlets are those whose discharge is a function of the difference in levels between the water surface in the distributing channel and the water course.

15.4.1 Standing Wave Flume

The standing wave flume is a semi-module measuring discharge with a high degree of accuracy (viz., 1.5 percent) besides having the advantage that a single gauge reading upstream is all that required. In the standard standing wave flume evolved at Poona - the head required can vary from 8 to 15 percent of the upstream depth of water over the sill without affecting the discharge; the modular ratio (i.e., the ratio of the downstream water depth to the total upstream depth, measured above the sill level) can be as high as 85 percent in small flumes and 92 percent in large flumes. It can be best used when variable discharge needs to be measured accurately and also when facilities for supervision or for automatic recording for gauges are available. This flume was evolved by Crump (Punjab) and Inglis (Bombay) after carrying out intensive model investigations.



Longitudinal Section

Standard standing wave flume design

The flume comprises of

(1) An approach channel of suitable design,

(2) A bell mouth entrance,

(3) A throat with a horizontal bottom and vertical sides,

(4) A downstream glacis, and

(5) An expansion in which the flow is redistributed before it passes into the downstream channel and head is recovered.

It is essentially a broad-crested weir and its discharge is given by formula

$$Q = C_o \; CBH^{1.5}$$

in which, B is the width of the throat, H is the total head (depth of water upstream y_1 + head due to velocity of approach h_v) on the upstream side sill level, and C is a coefficient to allow for losses due to friction, eddies, impact shock, etc.

Values of C and adjusted values of the constant for properly designed flumes without piers are given in Table.

Discharge in m^3/s	C	C_0
0.06 - 0.28	0.97	3.00
0.30 - 1.40	0.98	3.03
1.40 - 14.0	0.99	3.06
over 14.0	1.00	3.09

More abrupt curves than in the standard design will slightly lower the coefficient. The coefficient C (=0.99) for discharges from (1.4 to 14 m^3s^{-1}) was confirmed by actual observations carried out on the prototype in Sind.

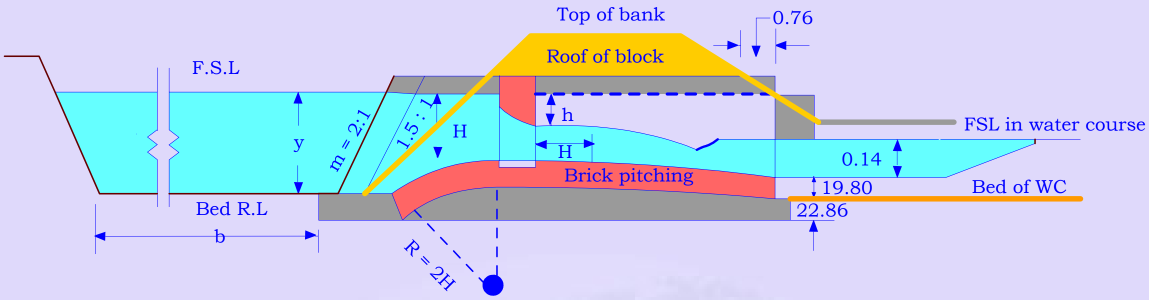
With piers, loss of energy due to shock which lowers the value of C. In Sind, falls and fall regulators were designed using the values shown in Table above, but observations showed that C was much lower, the average value of C for discharges 110 to 280 m^3s^{-1} on the Rohri Canal being about 6 percent lower. Based on the experimental investigations carried out at the Central Water and Power Research Station, Poona, in 1933, the following formula is suggested with the piers:

$$Q = C\left(B - k\; n\; H\right)H^{1.5}$$

in which, 'k' is the coefficient of contraction due to piers, (0.82 with standard piers), n is the number of piers, B is the waterway, C = 3.088, and H = total head (including velocity head).

15.4.2 Crump's Adjustable Proportional Semi-Module

This semi-module can be either of the orifice type or of the open type and fixed at the head of the outlet. These have been used extensively in Punjab.



Longitudinal Section

Crump's Adjustable Proportional Semimodule

15.4.3 Lindley Type Standing Wave Flume

This is a short throated flume with one side straight and the other curved. This is normally used as an outlet for water courses taking off at right angles from the distributary.

GIBB Module:

The main disadvantage of a non-modular outlet is that cultivators can draw more water by tampering in large numbers on a canal system.

Gibb module was found to be the only module which has no moving parts. As against modules whose working depends on floats or other moving mechanisms there are a few devices in which the discharge is automatically regulated by the velocity of the water itself without the necessity of any moving parts. Gibb an Executive Engineer of the irrigation Department, Punjab devised a module form of outlet, which was built for the first time on the Melay distributory of the Lower Thelam Canal. This module is named as Gibb module after its inventor and it gives an almost constant discharge over a considerable range, irrespective of the upstream and downstream water levels. It is one of the rigid modules without any moving parts. It does not need any supervision and cannot be easily tampered with.

Water is led through an inlet pipe (See Figure) into a spiral rectangular trough (eddy chamber) in which free vortex flow is developed. The water on the outside of the curve rises in level and the water surface slopes towards the inner wall. A number of baffles are inserted in the eddy chamber with their lower edges sloping at the required height above the bottom. As the head increases, the water banks up at the outer circumference of the eddy chamber and impinges against the baffles imparting an upward rotational direction of flow to the water, which spins round in the compartment between two successive baffles and finally drops on the on-coming stream of water, thus, dissipating excess energy and keeping the discharge constant. The degree of turn of the spiral depends on the volume of discharge and the working range required and generally varies from one semi-circle to one and a half complete circles.

Though this module gives constant discharge, it has the following disadvantages.

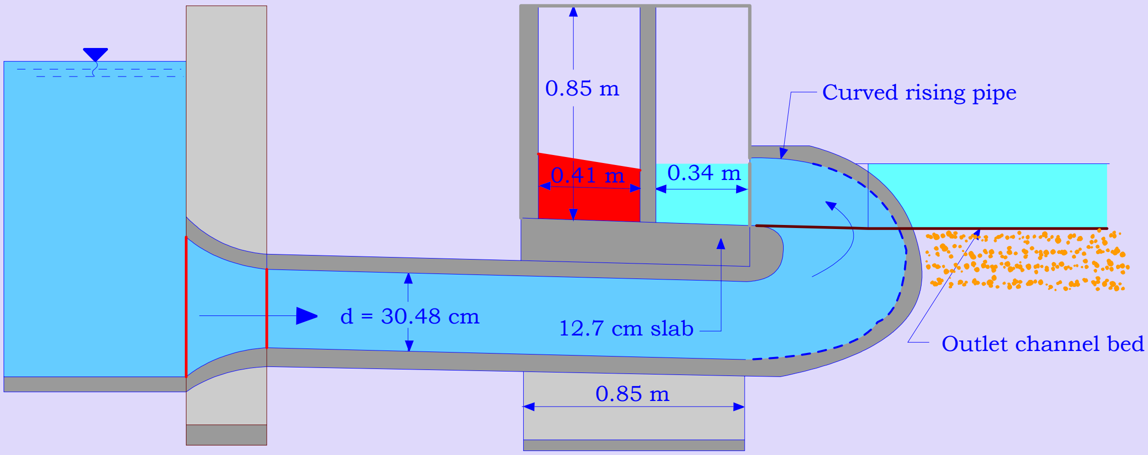
1. This module could be easily tampered with by breaking the baffles and eddy chamber.

2. It is costlier than other types of outlets.

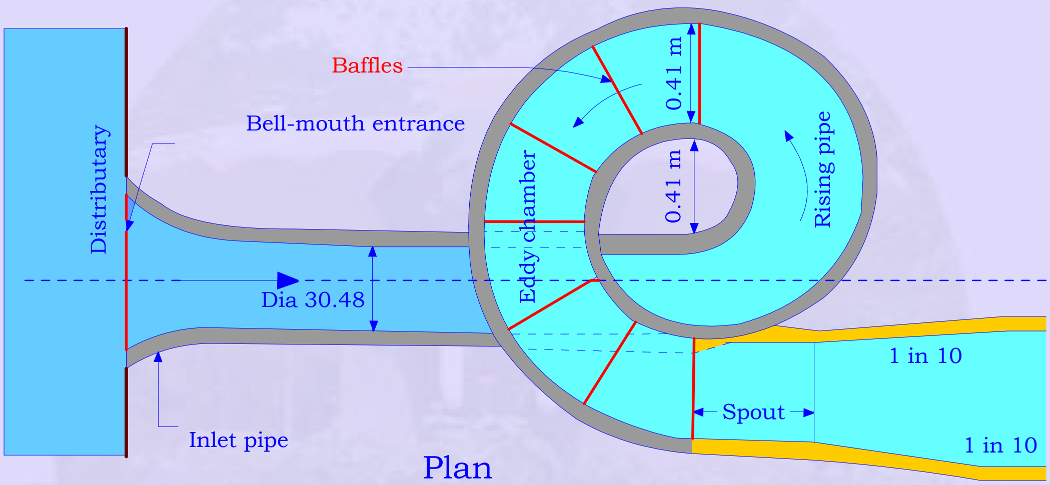
3. Construction of this module is a very difficult process and needs higher technical skills.

4. It is said to have a lot of trouble regarding silt drawal. The vent is likely to be choked by the silt and floating materials coming in the channel and periodical cleaning may be difficult.

Under the circumstances stated above this module can be used in places where small drawals are required for small plots from main channels. For e.g. in channel having 0.5 m^3/s flow a plot of 40 hectares will be requiring 0.03 m^3/s and the depth of flow in the main channel will less than 0.4 m. Under such circumstances this will ensure minimum losses due to the small branches taking off from main canal.



Longitudinal Section



Plan
Gibb module


Side view of Gibb's Module Eddychamber


Gibbs Module (Eddy chamber in action)


Gibb's Module (Side View)


Gibb's Module (Downstream View)