IRRIGATION OUTLETS

Definition:-

It is a hydraulic structure, which conveys irrigation water from a state-owned distributary to private-owned watercourse.

State-owned distributary:
A water channel which owned, and operate and maintained at the cost of government.(Canal – Branch Canal –Distributary – Minor – Subminor)

Private-owned watercourse:
A water channel, which is maintained at the cost of farmers.

The following characteristics are assumed for the performance of an outlet

i) Flexibility
It is the rate of change of outlet discharge to the rate of change of discharge of parent channel.

ii) Sensitivity:-
It is defined as the ratio of the rate of change of discharge of an outlet to rate of change in the level of distributary water surface i.e normal depth of channel.

iii) Efficiency
This is defined as the ratio of the head recovered to the head put in.

iv) <u>NOTATIONS & DEFINITIONS</u>

A.O.S.M	Adjustable Orifice Semi Modular
A.P.M	Adjustable Proportionate Modular
Bt	The width of the throat of a view flume etc
F.S.D	Full Supply Depth
F.S.L	Full Supply level
Hm	Minimum working head

V). <u>Module</u>
A device for ensuring a constant discharge of water passing from one channel into an other irrespective of water level in each , within specified limits.

Types of Outlets

Non-Modular:
It is an outlet in which discharge of outlet depends in water level of watercourse and the parent channel. This means that a cultivator can be drawn more discharge of water illegally by lowering the water level in watercourse (pipe or banal type and secretly outlet).

Semi Modular:
It is an outlet in which the discharge of outlet depends upon the water level in the distributray only and is independent of the water level watercourse (open flume and A.O.S.M).

Modular:
It is rigid module in which discharge is independent of the level in the distributary as well as watercourse.

Types of Outlet used in Punjab

i) Open Flume
ii) Pipe Outlet
iii) Adjustable Orifice Semi Modular
iv) Pipe – Cum – OF/AOSM

1. OPEN FLUME OUTLET

Formula

$$Q = KBt\ G^{3/2}$$

Where

Q = Discharge in lps

Bt = Throat width in meter

G = Head (Depth of water above Crest in m)

= F.S.L of canal – Crest level

Max F.S.L of watercourse = F.S.L of canal - Hm

Hm = 0.2 G

"Hm" is minimum modular head required for satisfactory performance of outlet.

Values of K & Bt in MKS system are given below.

K	**Bt (m)**
1600	0.06 – 0.09
1630	0.09 m – 0.12
1650	greater than 0.12

OPEN FLUME OUTLET

ii. PIPE OUTLET

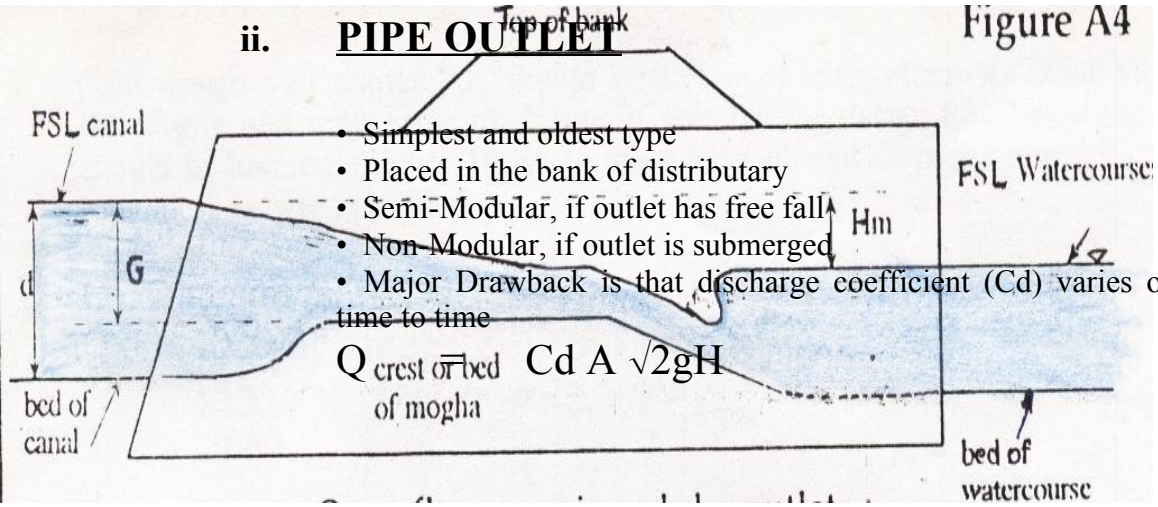


Figure A4

- Simplest and oldest type
- Placed in the bank of distributary
- Semi-Modular, if outlet has free fall
- Non-Modular, if outlet is submerged
- Major Drawback is that discharge coefficient (Cd) varies outlet to outlet & time to time

$Q_{\text{crest or bed of mogha}} = Cd\ A\ \sqrt{2gH}$

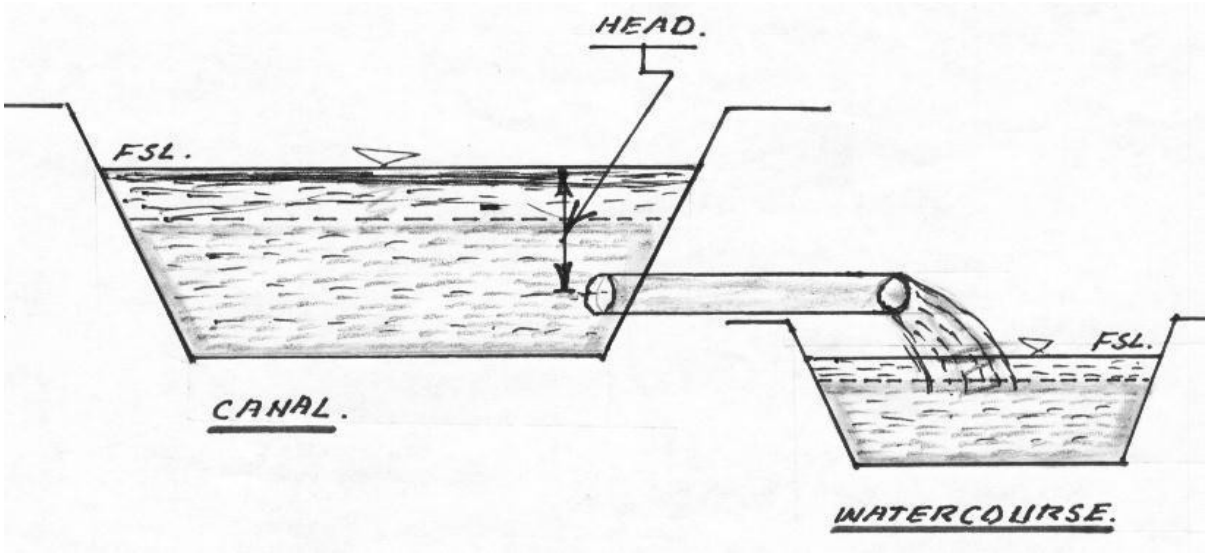
Free Flow Condition.

Q	=	Cd A √2gH
Q	=	Discharge in cubic meter per second
H	=	FSL of Canal – Center of pipe
A	=	Area of pipe (m^2), g = 9.80 m/sec/sec
C_d	=	0.63

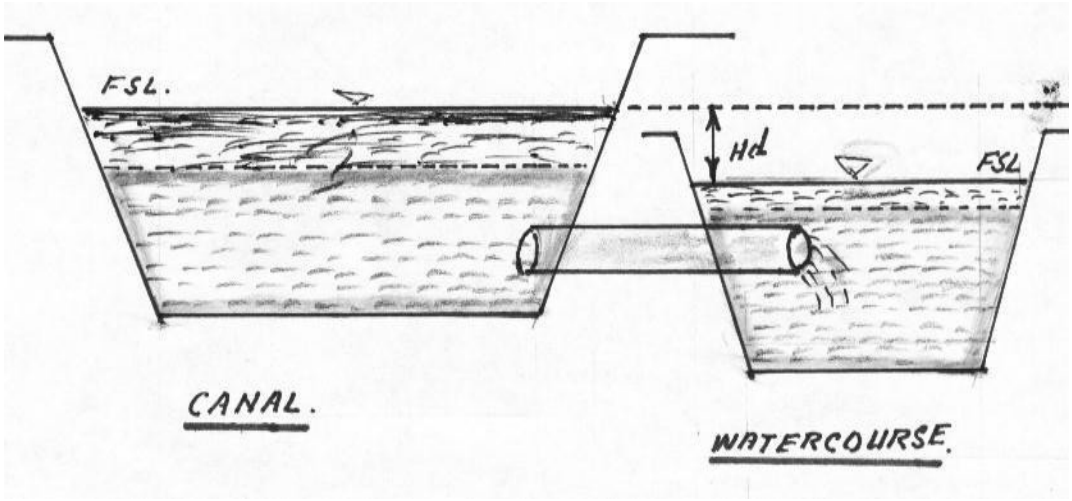
Submerge Flow Condition

Q	=	Cd A √2gHd
Q	=	Discharge in cubic meter per second
Hd	=	FSL of Canal – FSL of Watercourse
A	=	Area of pipe (m^2)
Cd	=	0.74

Pipe Outlet Free Condition



Pipe Outlet Submerged Condition



IRRIGATION OUTLETS CONTINUE

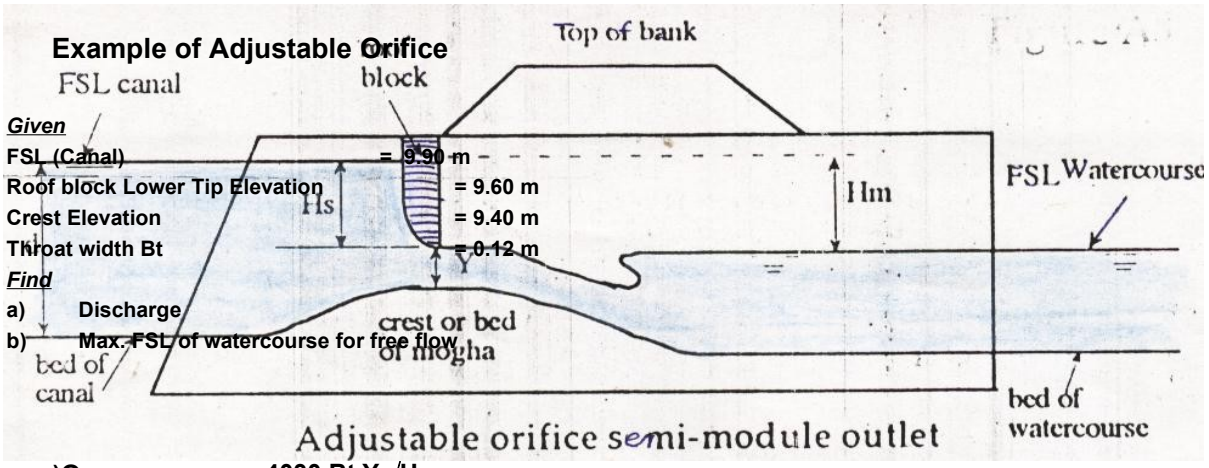
iii. Adjustable Orifice Semi Modular

Formula

$Q = 4030\ Bt\ Y\ \sqrt{Hs}$

where
Q = lps
Bt = Throat width (m)
Y = Distance between Lower Tip of Roof Block & Crest
Hs = FSL of Canal – Lower tip of Roof Block
FSL of Watercourse = FSL of Canal – Hm
Hm = 0.83 Hs – 0.5 Bt

Example of Adjustable Orifice



Given

FSL (Canal) = 9.90 m

Roof block Lower Tip Elevation = 9.60 m

Crest Elevation = 9.40 m

Throat width Bt = 0.12 m

Find

a) Discharge

b) Max. FSL of watercourse for free flow

a)Q = 4030 Bt Y √Hs

Hs = 9.90 – 9.60 = 0.30 m

Y = 9.60 – 9.40= 0.20 m

Q =

Solution

4030 x 0.12 x 0.2 √0.3 = 53 lps

b). Max. FSL of Watercourse

= FSL of Canal – Hm

Hm = 0.83 x 0.30 – 0.5 x 0.12 = 0.189 m

Max-FSL of Watercourse

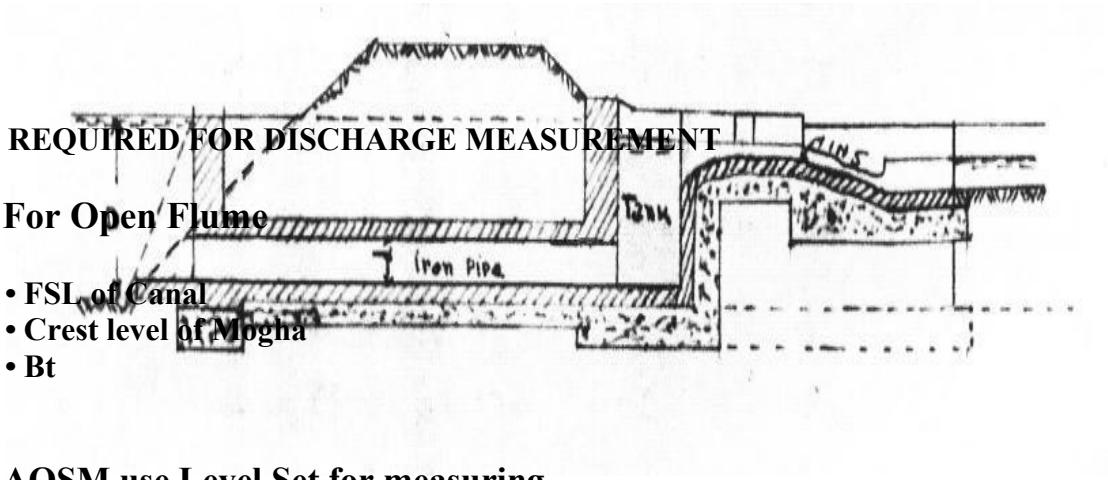
= 9.90 – 0.189 = 9.711 m or lower for free flow

Pipe-cum-AOSM

- Pipe from canal leads to a sump or cistern
- Sump is usually round in shape
- It can replace submerged Scratchley outlet
- On lined distributaries being installed
- Head will be measured in cistern
- Discharge will be equal to the semi-module fixed at its lower end

Merits of Pipe-cum-Semi Module

- High degree of immunity
- Large range of modularity (good at even at low supply)
- Low head required
- Cheaper in heavy banks
- Easy inspection
- Easy and cheaper adjustment
- Adjustment possible even with running channel
- **Note**: Formulae is same as for OF or AOSM as the case may be



DATA REQUIRED FOR DISCHARGE MEASUREMENT

a). **For Open Flume**

- **FSL of Canal**
- **Crest level of Mogha**
- **Bt**

b). AOSM use Level Set for measuring

- **FSL of Canal**
- **Lower tip of Roof Block**
- **Crest level of Mogha**
- **Bt**
- **Y**

c). For Pipe & Scratchley use Level Set for measuring

- **FSL of Canal**
- **FSL of watercourse**
- **Diameter of pipe**