**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) NOTATIONS & DEFINITIONS**

**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). Module**

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**

1. Open Flume
2. Pipe Outlet
3. Adjustable Orifice Semi Modular
4. 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

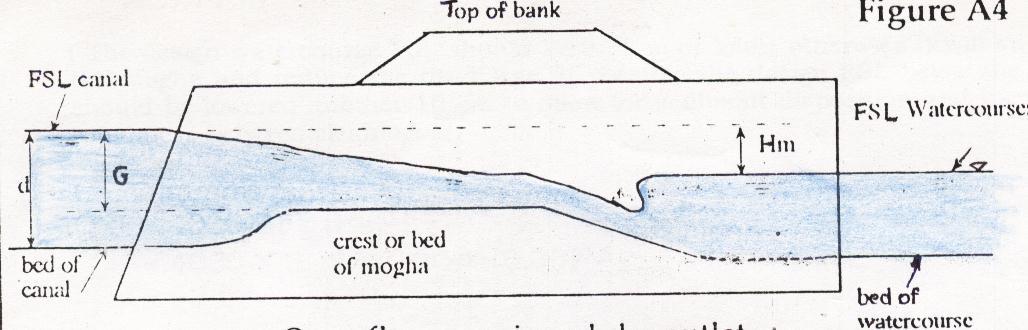
Hm = 0.2 G

“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**

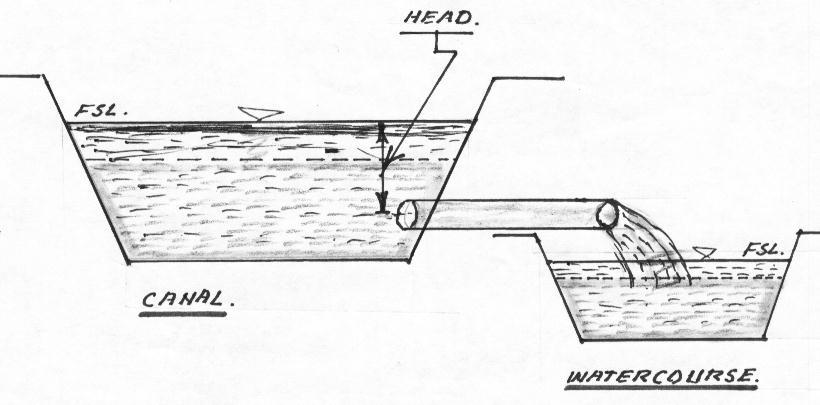
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1. **PIPE OUTLET**
   * Simplest and oldest type
   * Placed in the bank of distributary
   * Semi-Modular, if outlet has free fall
   * Non-Modular, if outlet is submerged
   * Major Drawback is that discharge coefficient (Cd) varies outlet to outlet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

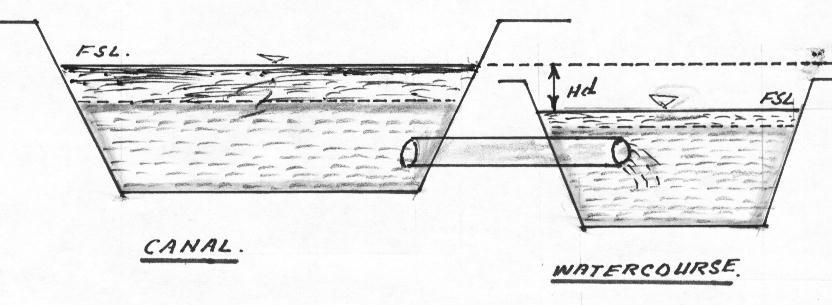
Q = Cd A 2gH

|  |  |  |  |
| --- | --- | --- | --- |
| ***Free Flow Condition*.** | | Cd A 2gH | |
| Q | = |
| Q | = | Discharge in cubic meter per second | |
| H | = | FSL of Canal – Center of pipe | |
| A | = | Area of pipe (m2 ), g = 9.80 m/sec/sec | |
| Cd | = | 0.63 |  |
| ***Submerge Flow Condition*** | | | Cd A 2gHd |
|  | Q | = |
| Q | = | Discharge in cubic meter per second | |
| Hd | = | FSL of Canal – FSL of Watercourse | |
| A | = | Area of pipe (m2 ) | |
| Cd | = | 0.74 |  |

**Pipe Outlet Free Condition**

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**Pipe Outlet Submerged Condition**

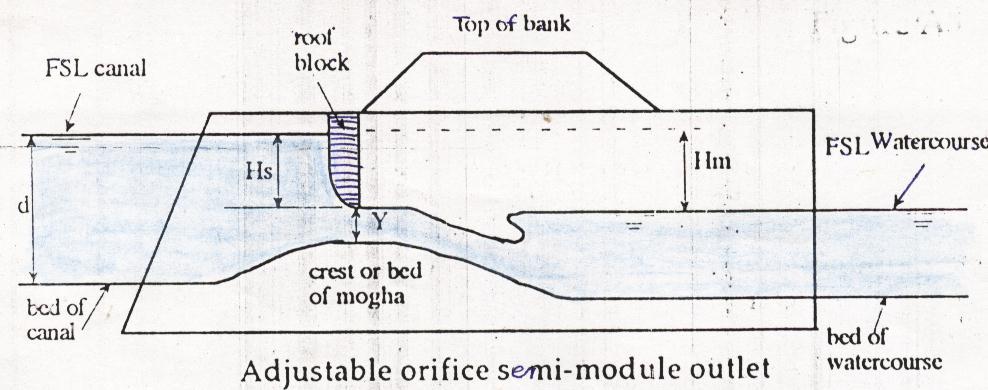


**IRRIGATION OUTLETS CONTINUE**

**iii. Adjustable Orifice Semi Modular**

**Formula**

|  |  |  |
| --- | --- | --- |
| Q | = | 4030 Bt Y 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 |
|  |  | |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |



**Solution**

**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** |

1. **= 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**

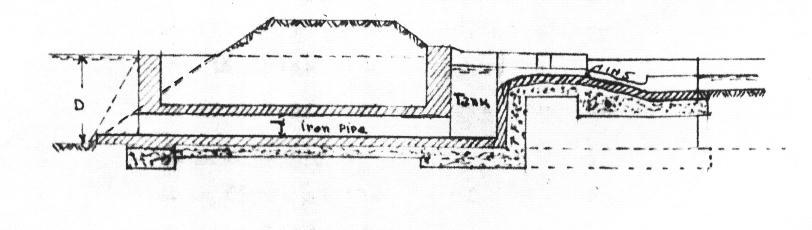
**= 9.90 – 0.189 = 9.711 m or lower for free flow**

**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**