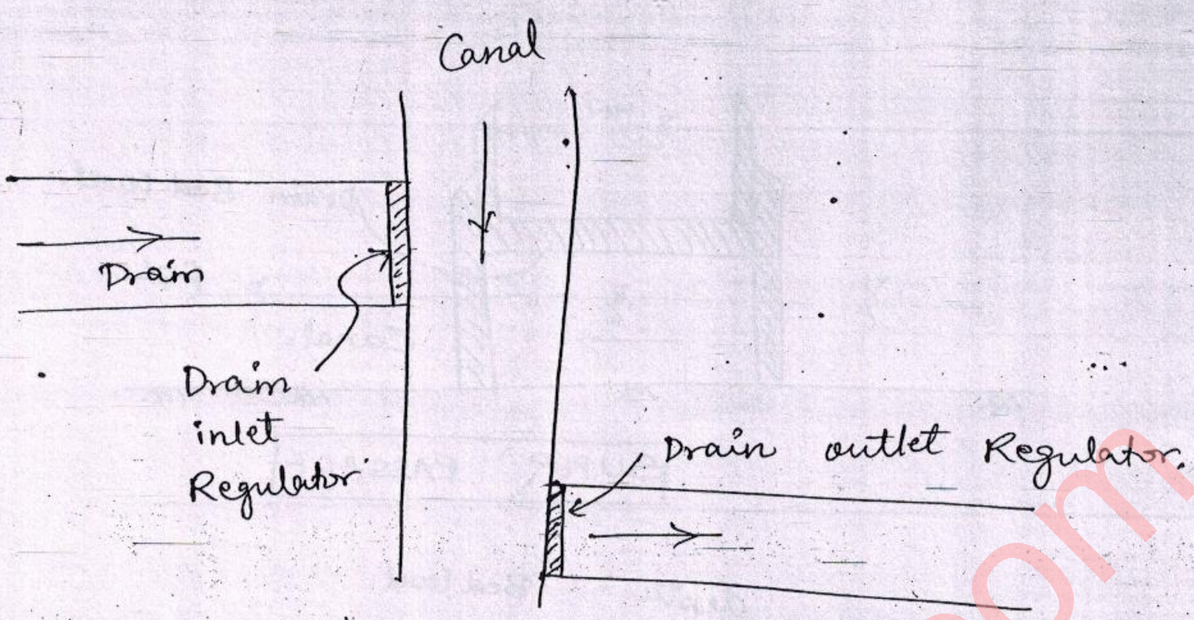


INLET & OUTLET

DESIGN OF TRANSITIONS

- In case of large Canals or drains, the width of the canal or drain is reduced at the section where cross drainage work is to be provided. This gradual reduction in width is known as Transition. which can be designed by any of following methods:-

(1) MITRA'S Method.

(2) CHATURVEDI'S Method.

MITRA'S Mtd :- In this method, transition is assumed to be Hyperbolic.

- This method is used when the depth and discharge is constant and the velocity of flow varies with the width.

- In this method, it is assumed, that the rate of change of velocity per unit length is constant for the entire length ~~loss~~ of the transition.

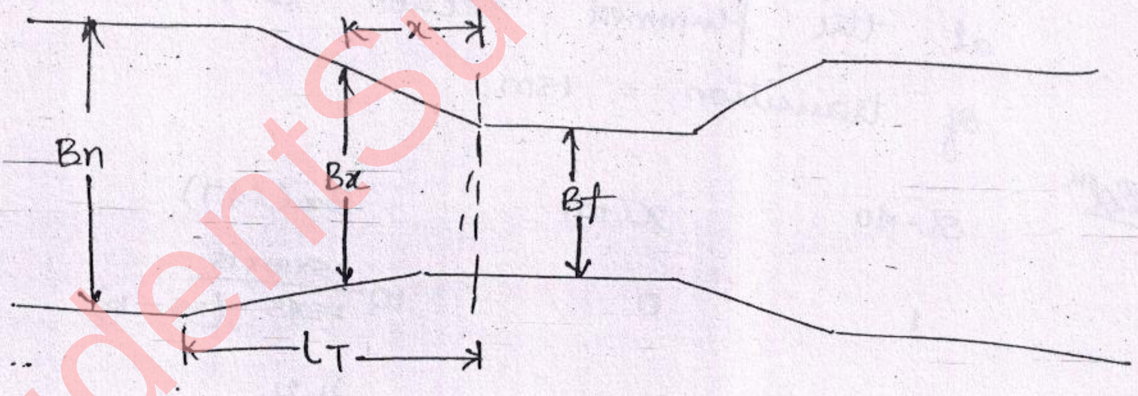
- The width of transition at any section can be calculated by the following relation:-

$$B_x = \frac{B_n \cdot B_f \cdot L_T}{B_n \cdot L_T - (B_n - B_f)x}$$

B_n = Normal width of the channel.

B_f = Width of channel at flummed section.

L_T = Length of transition.



(2) CHATURVEDI'S METHOD :-

- In this method the transition is assumed to be semi cubical parabola.
- This method is used when the depth of flow is constant.

⇒ Width at any section can be calculated using the following relation.

$$x = \frac{L_T \cdot B_n^{3/2}}{B_n^{3/2} - B_f^{3/2}} \left\{ 1 - \left(\frac{B_f}{B_x} \right)^{3/2} \right\}$$

Q ES 2010 Design a transition using mitra's hyperbolic curve given following relation:-

(same as last page)

and compare it with chaturvedi's semi cubical parabolic transition curve given by

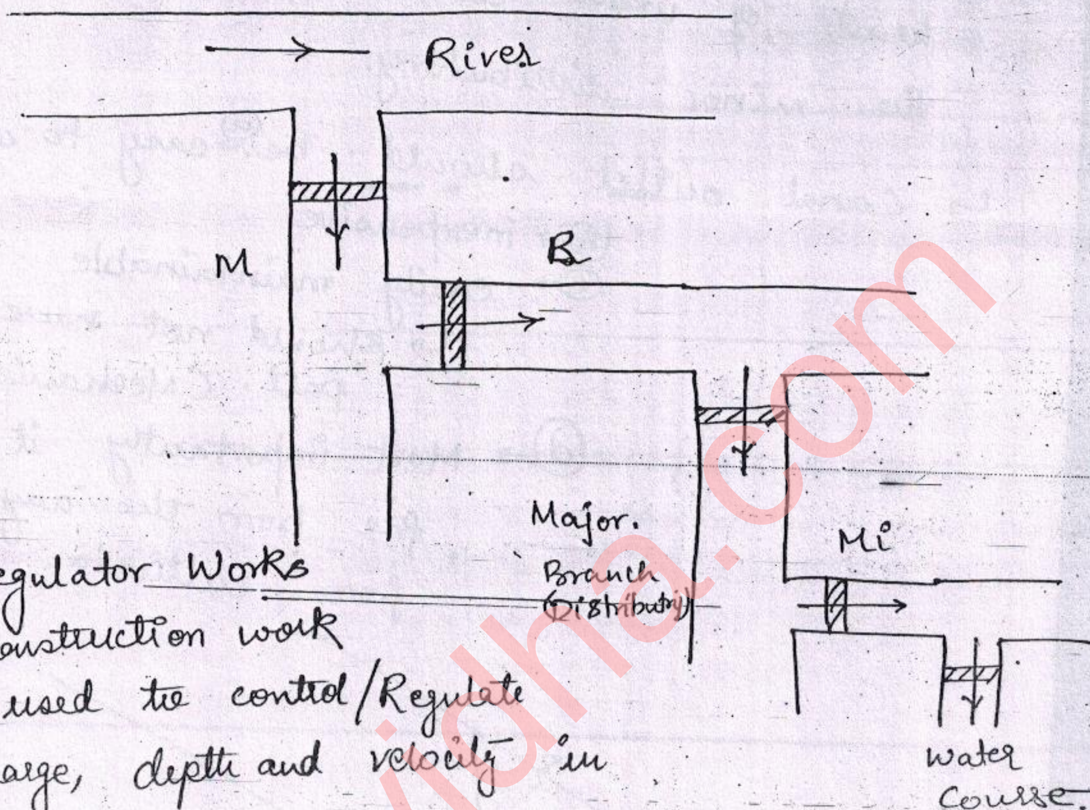
(same as above).

if normal width of flow is 25m. Width at the flummed section is 10m and length of transition = 15m.

Solⁿ

SL-NO	x(m)	Bx(MT)	Bx(CT).
1	0	$10 \frac{25\times10\times15}{25\times15 - (25-10)}$	
2	3	11.36	
3	6	13.157	
4	9	15.625	
5	12	19.23	
6	15	25	

⇒ CANAL REGULATORS



- Canal Regulator Works is the construction work which is used to control/Regulate the discharge, depth and velocity in the canal in accordance with the Requirement of the particular canal.

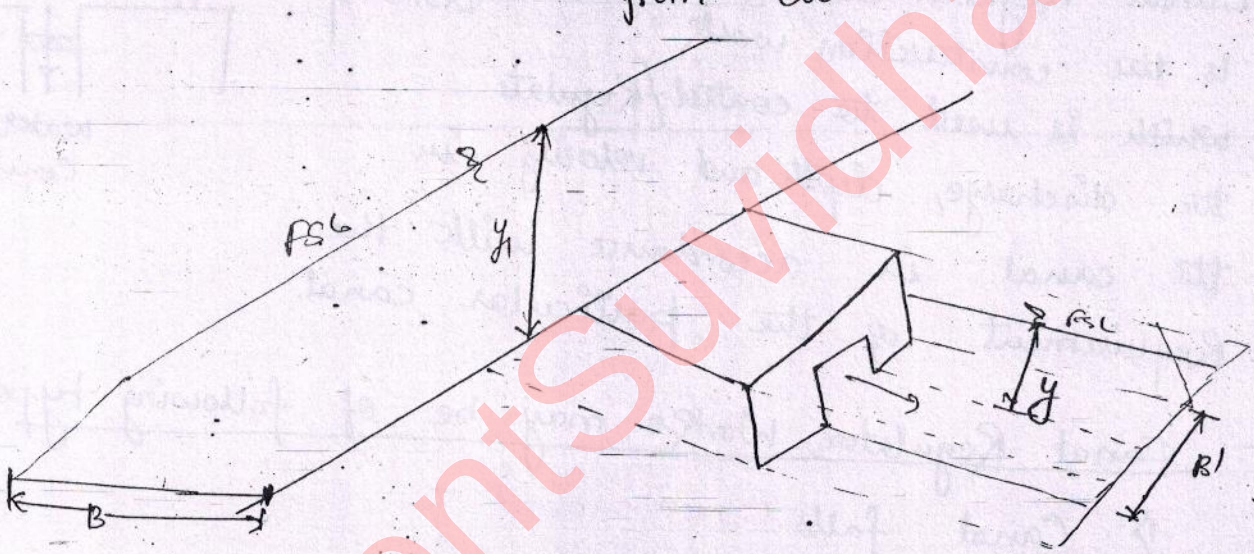
- Canal Regulator Works may be of following type:-

  i) Canal falls.
  ii) Canal Escapes.
  iii) Cross Regulator.
  iv) Metering flumes
  v) Canal Outlets/ Modules.

CANAL OUTLETS OR MODULE

↳ simple structure that is constructed at the head of water course so as to connect to the minor distributory.

↳ Canal outlet should be ⓐ→ easy to construct
ⓑ→ inexpensive
ⓒ→ easily maintainable
↳ should not have any movable part. (Mechanical parts)
ⓓ→ Most importantly it should be free from the any interference from cultivator.



for wide Rectangular Channel.:

$$R = \frac{A}{P} = \frac{By}{B+2y} = \frac{By}{B} = y.$$

$$Q = \frac{B \cdot S^{1/2}}{N} \cdot y^{5/3}$$

∴ for any channel

$$\boxed{Q = c \cdot y^n}$$

c = constant
n = channel Index

$$Q = C \cdot y^n$$

for wide Rectangular Channel

- $C = \frac{B S^{1/2}}{N}$
- $n = \frac{5}{3}$

→ for orific type of outlet

$$Q = C_d \cdot A \cdot V$$

$$= C_d \cdot \frac{\pi d^2}{4} \cdot \sqrt{2gH}$$

Cd = coff. of drag.

$$Q = C_d \cdot \frac{\pi d^2}{4} \cdot \sqrt{2g} \cdot H^{1/2}$$

→ ∴ In General Discharge through any outlet

$$q = K \cdot H^m$$

K = constant

m = outlet Index.

for orifice type outlet

- $K = C_d \cdot \frac{\pi d^2}{4} \cdot \sqrt{2g}$
- $m = 1/2$

→ for Weir Type outlet

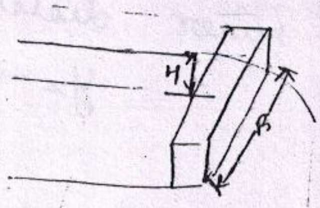
$$q = C_d \cdot (BH) \cdot \sqrt{2gH}.$$

$$q = C_d \cdot B \cdot \sqrt{2g} \cdot H^{3/2}$$

$$q = K \cdot H^m$$

$$q = K \cdot H^m$$

$m = \frac{3}{2}$



(H) → Head above Weir.

- outlet discharge depends upon
  - Head available
  - also on both the heads of canal and outlet.

⇒ TYPE OF CHANNEL OUTLETS --

(1) NON - MODULAR OUTLET :-

- It is the type of Outlet thru which discharge is dependent upon the difference of head b/w the minor distributary and ~~outlet~~ the water course
  i.e ($H = y_1 - y_2$)

- Discharge ~~the~~ through these outlet Varies widely with the either change of depth in the channel or in the water course.

(2) FLEXIBLE OUTLETS OR SEMIMODULAR OUTLETS :-

- These are the type of outlets, discharge through which, is independent of the depth of flow but is dependent upon the depth of flow in minor distributory

  $y_2 \rightarrow$ ⊗ ; $y_1 \rightarrow$ ✓ i.e $q \propto f(y_1)$.

③ RIGID OR NON FLEXIBLE OUTLETS

These are the type of outlets, discharge through which is constant within the fixed limit. i.e it is independent of depth of flow in either minor distributory or water course

i.e q = constant. (within fixed limit)

⇒ FACTORS EFFECTING THE EFFICIENCY OF OUTLET

① Flexibility (F) = Ratio of rate of change of discharge to the rate of change of discharge thru channel.

$$F = \frac{\text{Rate of change of discharge in outlet}}{\text{Rate of change " " " Channel}}$$

$$F = \frac{dq/q}{dQ/Q}$$

↳ $Q = C \cdot y^n$

$dQ = C \cdot n \cdot y^{n-1} \, dy$

$$\frac{dQ}{Q} = \frac{C \, n y^{n-1}}{C \cdot y^n} dy = \frac{n}{y} dy.$$

$$\frac{dQ}{Q} = \frac{n}{y} dy.$$

↳ $q = K H^m$

$dq = K \cdot m \cdot H^{m-1} \cdot dH$ ⇒ $\dfrac{dq}{q} = \dfrac{m}{H} dH$

$\therefore \quad F = \dfrac{\frac{m}{H} \cdot dH}{\frac{n}{y} \cdot dy}$

$$F = \frac{m \times y}{n \times H} \cdot \frac{dH}{dy}$$

$H = y_1 - y_2$

$y_1 = y$

$H = y - y_2$

$dH = dy$

$\frac{dH}{dy} = 1$

— $y_1 = 5 \quad y_2 = 3m.$

$H_1 = 5 - 3 = 2m.$

— $y_1 = 6m \quad y_2 = 3m.$

$H_1 = 6 - 3 = 3m.$

$\therefore$ Change in the Head over outlet = change in depth of flow in minority channel.

$$\boxed{F = \frac{m\, y}{n \cdot H}}$$

(2) PROPORTIONALITY :-

→ An outlet is said to be proportional if the rate of change of discharge through outlet is equal to rate of change of discharge in the channel.

i.e $\dfrac{dq}{q} = \dfrac{dQ}{Q}.$

→ A channel is proportional if flexibility = 1.

i.e $\boxed{\dfrac{my}{nH} = 1}$ for channel to be proportional.

$\boxed{\dfrac{H}{y} = \dfrac{m}{n}}$ — m: outlet index, n: channel index.

Note :- The ratio of $\left(\frac{H}{y}\right)$ is known as **SETTING**

→ Head (H) = depth of flow below F.S.L.

↳ **SETTING**

→ for an orifice type of ~~Chan~~ outlet constructed on wide Rectangular channel to be proportional.

$$\frac{H}{y} = \frac{m}{n} = \frac{1/2}{5/3} = 0.9$$

→ for weir type on wide Rectangular Channel.

$$\frac{H}{y} = \frac{m}{n} = \frac{3/2}{5/3} = 0.9$$

⇒ HYPER PROPORTIONAL OUTLET

- An outlet is said to be hyper proportional if its flexibility > 1

i.e $F > 1$

i.e $\frac{dq}{q} > \frac{dQ}{Q}$

(Rate of discharge thru outlet) > (Rate of discharge thru channel)

$$\frac{my}{nH} > 1$$

$$\frac{H}{y} < \frac{m}{n}$$

Setting.

⇒ $\frac{H}{y} < \left(\frac{H}{y}\right)_P$ ← Reqd Head for proporti

⇒ $H < \left(\frac{m}{n} \cdot y\right)_P$ Head Reqd

⇒ SUB PROPORTIONAL OUTLET

→ An outlet is said to be sub proportional if its flexibility < 1

i.e $\boxed{F < 1}$

or $\boxed{\frac{dq}{q} < \frac{dQ}{Q}}$

or $\frac{my}{nH} < 1$

or $\boxed{\frac{H}{y} > \frac{m}{n}}$

or $\boxed{\left(\frac{H}{y}\right)_{\text{given setting}} > \left(\frac{H}{y}\right)_{\text{Reqd for proportion. setting}}}$

or

$$H > \left(\frac{m}{n}\right) y$$

i.e $(H)_{\text{given}} > (H)_{\text{Reqd for proportional}}$

③ SENSITIVITY (S):-

— it is defined as the ratio of Rate of change of discharge thru the outlet to the rate of change of depth of flow in the channel.

$$\boxed{S = \frac{dq}{q} \Big/ \frac{dy}{y}}$$

$$f = \frac{\frac{dq}{q}}{\frac{dQ}{Q}}$$

$Q = K \cdot y^n$

$dQ = K \cdot n \cdot y^{n-1} \cdot dy$

$$\frac{dQ}{Q} = \frac{n \cdot dy}{y}$$

$$f = \frac{\frac{dq}{q}}{n\left(\frac{dy}{y}\right)}$$

$$f = \frac{S}{n} \Rightarrow \boxed{S = n \cdot F}$$

n = channel Index.

Eg
↳ for wide Rectangular channel (proportio

$$S = \frac{5}{3} \cdot \quad \text{as } F = 1$$