Subject :: Irrigation Engineering

Submitted by :: Faisal Khan

ID :: 7821

Section :: A

Semester :: 6th

Instructor :: Dr Jehangir Durrani

Note :- Attempt all Questions.

Q1 (a) Explain anti Water-logging measure:-

Ans Water logging Control:-

- The Quantity of water into Soil below is reduced.
- Inflow into underground reservoir is reduced and outflow should be increased.

Method of Control of water logging:-

1 Lining of Canals & water courses:-
It reduce Seepage of water.

2 Reducing intensity of irrigation:-
Only Small portion of land Should receive Canal water in one particular Season.
Remaining areas Can receive water in next Season by rotation.

3 By Introducing Crop rotation:-
High water requiring Crop Should be followed by one requiring less water, & then by one requiring almost no water.
Example: Rice followed by Wheat & then by Cotton.

4 Optimum use of water:-
Certain amount of water gives the best result. Less or more water reduce the yield. Cultivators should be educated so that not to use more water.
Revene should be charged on the basis of quantity of water rather than the area of land.

5 Improving natural drainage of area:-
Water should not be allowed to stay in one area.
Natural flow is provided by blush & Jungle Cutting.

6 Pumping or tubewells or vertical drainage:-
Lift irrigation should be introduced to use G.W. Canal irrigation may be substitude by tubewell irrigation.

7 Economical use of water according to need.

8 Adoption of Sprinkle method of Irrigation:-
Onl predetermined amount of water is supplied to land. No percolation loses from water courses.

(b) Differentiate b/w Saline & Alkaline Soil:-

Ans Saline and alkali soil are soil that been formed by Soluble Salt, Consisting mainly of (Sodium, Calcium, magnesium, Chloride, and Sulphate)

The key difference between Saline and alkaline Soil is that "Saline Soils have a PH less that 8.5 and an exchangeable Sodium percentage less than 15. while alkaline Soils have a PH greater than 8.5 and an exchangeable Sodium percentage higher than 15". Mean while, neutral Soil have PH 7.

(C) How do you reclaim Salt affected lands?

Ans Following are the point of the reclaim Salt affected lands.

* By Maintaing the water table Sufficenty below the roots.
* Prevent all the measures which were Suggested of prevent water logging hold good for

preventing the Salinity of lands.

* An efficient drainage (Surface & Sub Surface must be provided to lower the water table in Saline Soils.
* The practice of Crop, reversals is necessary to reduce the estimate of Salt or efflorescence.
* land Should be folded with water so that alkaline Salts will be dissolved in water.
* High Salt resistant Crop like rice are grown on leached land for 1 or 2 Seasons.

Q2 (a) Explain the procedure of designing of an irrigation Canal by Kennedy's theory:-

Kennedy's Theory:-

R. G Kennedys studied Straight reaches of upper Bari Doab canal which are stable for 30 years.

$V_o = CD^n$

Where V_o is Critical velocity (non Silting or non Scouring)

"C" is Constant depend upon quantity of Silt.

Sediments is kept in Suspension Solely by the vertical Component of eddies.

- weight of Sediment vertically acts downward.
- Vertical Component of eddies acts upward.
- Result the Sediments in Suspension
- $V_o = 0.546 D^{0.64}$ MKS System
- $V_o = 0.84 D^{0.64}$ FPS System
- $V_o = 0.546 m D^{0.64}$ Where $m = V/V_o$ = Critical velocity ratio (C.V.R) depends upon Silt grade.

Kennedy Procedure for Canal design :-

Step# 01

Assume the trial value of "D" & put in eqn. 1 and determine.

$$V_o = 0.546 m D^{0.64}$$

Step# 02

In eqn 1 $Q = AV$

$$A = Q/V$$

$$A = BD + D^2/2$$

$$P = B + D\sqrt{5}$$

Assumed D & fine B $\therefore R = A/P$

Step# 03

Substitute the value of R in eqn 2 (Kutters & Chazys eqn) to obtain V which will be the actual velocity for assumed dimension.

Step# 04

If the velocity worked out from Eqn. 2 agree with that of obtained with the Eqn 3

(Kennedeys Eqn) Then the assumed depth is Correct. Other wise repeat the procedure with Changed value of "D".

b) Design an irrigation Channel by Kennedy's theory to cary a discharged of 30 Cumec with Cvr(m) of 1 & N = 0.0225 & bed slope of 1/5000. Assume D = 2.3m

Sol:-

Given Data:-

Discharge (Q) = 30 m^3/sec , Cvr(m) = 1

N = 0.0225 , Bed slope = 1 in 5000

d = 2.3m

Solution:-

Find velocity By formula:-

$V_K = 0.546\, m D^{0.64}$

$V_K = 0.546(1)(2.3)^{0.64} \Rightarrow$ **0.930m**

Now Calculating Area of Canal

$Q = AV \Rightarrow A = Q/V$

$A = 30/0.930 = 32.25\ m^2$

$A = 32.25\ m^2$

⇒ Now Calculate B By using

$$A = BD + \frac{D^2}{2}$$

$$A = BD + 0.5D^2$$

Put values in the above eqn

$$32.25 = B(2.3) + 0.5(2.3)^2$$

$$32.25 - 2.645 = 2.3B$$

$$\boxed{B = 12.87m}$$

⇒ Now Calculate wetted pesimeter

$$P = B + \sqrt{5}D$$

$$P = 12.87 + \sqrt{5}(2.3)$$

$$\boxed{P = 18.01\ m}$$

⇒ Calculate Hydraulic Radius

$$R = A/P \Rightarrow \frac{32.25}{18.01}$$

$$\boxed{R = 1.79m}$$

⇒ Calculate mean velocity by Chezy eqn.

$$V_c = C(RS)^{1/2}$$

Where

$$C = \frac{\frac{1}{n} + \left(23 + \frac{0.00155}{S}\right)}{1 + \left(23 + \frac{0.00155}{S}\right)\frac{n}{\sqrt{R}}}$$

$$= \frac{\frac{1}{0.0225} + \left(23 + \frac{0.00155}{(1/5000)}\right)}{1 + \left(23 + \frac{0.00155}{(1/5000)}\right) \times \left(\frac{0.0225}{\sqrt{1.79}}\right)}$$

$$C = \frac{75.19}{1.517} = 49.56$$

$$\Rightarrow V_c = 49.56\left(1.79\left(\frac{1}{5000}\right)\right)^{1/2}$$

$$\boxed{V_c = 0.93 m}$$

Q: (a) Differentiate b/w initial regime & final regime in accordance to Lacey's theory:-

Ans Initial Regime:-
When only bed slope of Channel changes but the cross section remain same then also no silting or scouring take place. But this is rare.

Final Regime:-
If all the parameters (Perimeter, depth & slop) have equally free to vary & adjust according to discharge & silt grades then the Channel is said to have final regime.

(b) Design a regime Channel by laceys theory for discharge of 30 Cumecs & mean dia of silt particles of 0.56mm.

Given data:-
$Q = 30 m^3/sec$
$M = 0.56 m$

Sol:-

Silt Factor = $f = 1.76 \times M^{0.5}$

$f = 1.76 \times (0.56)^{0.5}$

$f = 1.3$

$$v_m = \left[\frac{Qf^2}{140}\right]^{1/6}$$

$$= \left(\frac{30 \times (1.3)^2}{140}\right)^{1/6}$$

$v_m = 0.844$

$\Rightarrow Q = AV \Rightarrow A = \frac{Q}{V} = \frac{30}{0.844}$

$$\boxed{A = 35.54}$$

$P = 4.75\sqrt{Q} \Rightarrow 4.75\sqrt{30}$

$$\boxed{P = 26.01}$$

$\Rightarrow R = \frac{5}{2} \times \frac{v^2}{f} \Rightarrow \frac{5}{2} \times \frac{(0.844)^2}{1.3}$

$$\boxed{R = 1.36}$$

$$A = BD + \frac{D^2}{2}$$

$$35.54 = BD + \frac{D^2}{2} \quad \text{—(1)}$$

$$P = B + D\sqrt{5}$$

$$26.01 = B + 2.236D \quad \text{—(2)}$$

Put eqn (2) in (1)

$$35.54 = (26.01 - 2.236D)D + \frac{D^2}{2}$$

$$35.54 = 26.01D - 2.236D^2 + 0.5D^2$$

$$35.54 = 26.01D - 1.736D^2$$

$$\underbrace{-1.736D^2}_{\alpha} + \underbrace{26.01D}_{\beta} \underbrace{-35.54}_{c} = 0$$

By Quardatic formula

$$D = \frac{-(26.01) \pm \sqrt{(26.01)^2 - 4(-1.736)(-35.54)}}{2(-1.736)}$$

$$\boxed{D = 1.52}$$

Put in eqn (2)

$$B = 26.01 - 2.236(1.52)$$

$$\boxed{B = 22.611}$$

$$S = \frac{f^{(5/3)}}{3340\, Q^{1/6}}$$

$$S = \frac{(1.3)^{5/3}}{3340\,(30)^{1/8}}$$

$$\boxed{S = 0.00026}$$

Q4 (a) Explain the Components of headwork with neat diagram :-

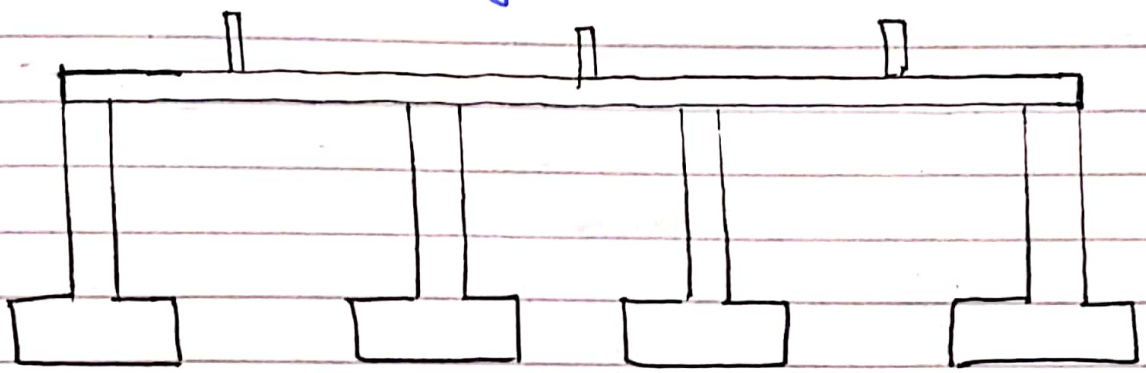
Ans Components of a diversion headwork:-

(1) Weir :- Normally the water level of any perinnial river is such that it can not be diverted to the irrigation Canal. The bed level of the canal may be higher than the existing water level of rivers. Surplus water pass over the crest of weir.

(2) Barrage :- When the water level on the up stream side of the weir is required to be raised to different level at different time, barrage is Constructed. Barrage is arrangment of adjustable gates or Shutters at different fixes over the weir.

(3) Under sluices :- Also known as Scouring Sluces. The unders sluices are the openings provided at the base of weir or barrage. These openings are provided with

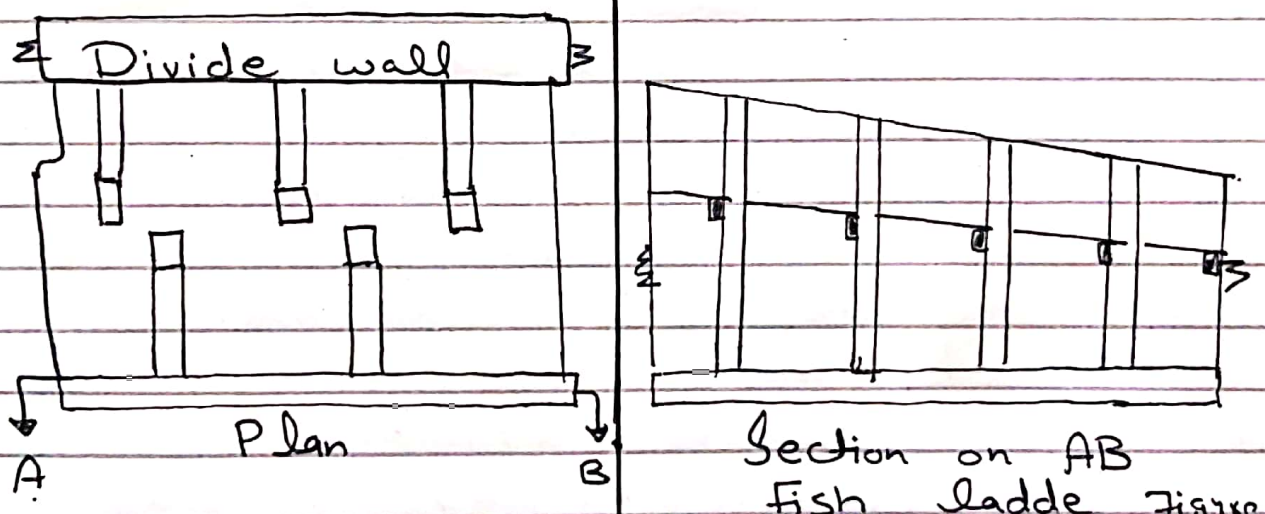
adjustable gates. Normally, the gates are kept closed. The Suspended Silt goes on depositing in front of the Canal head regulator. The muddy water flows towards the downstream through the Scouring sluices. The gates are closed. But, at the period of flood, the gates are kept opened.



(4) Divide wall :- The divide wall is a long wall constructed at right angles in the weir of barrage. It may be constructed with Stone massonry or Cement Concrete. On the upstream side, the wall is extended just to cover the Canal head regulator & on the downstream side it is extended up to the launching apron.

(5) Fish ladder:-

The fish ladder is provided just by the side of the divide wall for the free movement of fishes. Rivers are important sources of fishes. The tendency of fish is to move from upstream to downstream in winter from downstream to upstream in moonsoons. This movement is essential for their survival.

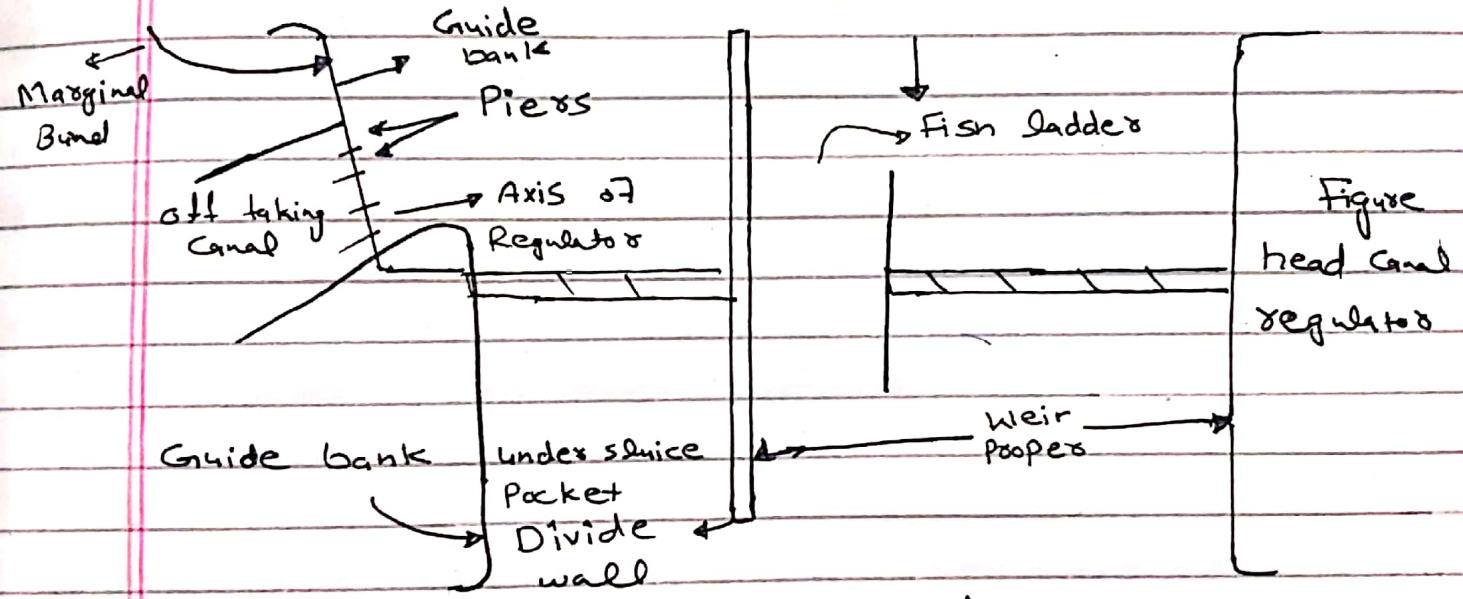


Fish ladde figure

(6) Canal head regulator :-

A structure which is constructed at the head of the canal to regulate flow of water is known as canal head regulator. It consist of numbers of piers which

divide the total width of the canal into a number of spans which are known as bays. The piers consist of no: of piers on which the adjustable gates are placed.



(7) Silt Prevention device:-
The entry of silt into a canal, which takes off from a head work, can be reduced by constructed certain special works, called silt control work. There are two types.

(a) Silt Excluders (b) Silt Ejectors.

Silt Excluder:- Silt Excluder are those work which are constructed on the bed of the river, upstream of the head regulator.

Silt Ejectors:- Those devices which extract the silt from the canal water after the silted water has traveled a certain distance in the off take canal.

(8) River training works:-
River training works are required near the weir site in order to ensure a smooth & an axial flow of water & thus prevent the river from out flanking the works due to a change in it course. The river training works required on a canal headwork are.
(a) Guide banks (b) Marginal bunds
(c) Spurs or groynes.

Guide bank:- When a barrage is constructed across a river which flows through the alluvial soil the guide banks must be constructed on both the approaches to protect the structure from erosion. guide bank protets the barrage from the effect of scouring & erosion.

Marginal Bunds:- The marginal bunds are earthen embankments which are constructed parallel to river bank on one or both the bank according to the condition. The top width is generally 3m to 4m. The side slope on the river side is generally 1.5:1 & that on the country side is 2:1

(b) What are the functions of head regulators:-

Ans The function of the canal head regulators are as follow:-

- It regulates the supply of water entering the canal.
- It control the entry of silt in the canal.
- It prevents the river-floods from entering the canal.
- To indicate the discharge passed into the canal from design discharge formula & observed head of water on the crest.