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Subject Irrigation Engineering

Semester 6th

Section B

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Question no: 01

Part (a):

Explain anti-water logging measures.

* **water Logging:** The Soil whose surface layer are saturated with water is called water-logged Soil. The phenomenon of rising water table is known as water logging.

* **Anti water-logging Measures:** For controlling water logging following measures are adopted.

(i) Efficient Surface Drainage: Efficient Surface drainage allows a quick flow of rain water ~~logging~~ in short short period that helps in reducing the water logging.

(ii) Restriction of irrigation: In one particular Season only a small portion of land should recieve canal water, Remaining area should be irrigated in next Season by rotation.

(iii) Lining of water courses: lining of Canals and water courses reduces the seepage of water.

(iv) Removing obstruction in natual drainage: water should cross with roads, railways, Canals to make more efficient.

(v) Optimum use of water: Certain amount of water gives the best result.

(vi) changes in Crop pattern

(vii) Adoption of Sprinkles method for irrigation

(viii) Prevention of Seepage from water reservoirs.

Question no: 01

Part (b):

Differentiate between saline and alkaline soils.

	Saline Soils	Alkaline Soils
①	By principle of Osmosis, the Pure water from root flows outwards in a plant die due to lack of water. Such soil is unreproductive and is called Saline Soils.	If the Salt efflorescence contines for a longer period, a base exchange reaction with clay takes place, thus sodiumizing the clay, making it impermeable, illaerated and highly Unproductive, Such soils are called alkaline soils.
②	It have high organic matter content.	It have low organic matter content.
③	It have PH level less than 8.5	It have PH level greater than 8.5.
④	Exchangable Sodium percentage is less than 15.	Exchangable Sodium percentage is more than 15.

⑤ The colour of soil is white or light gray.	The colour of soil is Black.
⑥ Most common ions are mainly Sodium chloride and sodium Sulphate, also calcium chloride, calcium sulphate, calcium Carbonate, magnesium sulfate, magnesium bicarbonate in small amounts.	mainly most common ions are Sodium carbonate, Potassium Carbonate. Calcium and magnesium carbonate in small amounts.
⑦ Electrical Conductivity is 4 or more mmhos/cm.	Electrical conductivity is usually less than 4mmhos/cm.

Question no: 01

Part (c): How do you reclaim salt affected lands?

Ans: The Salt affected lands are reclaimed by the following processes:

(i) By efforoscence and how to avoid:

⇒ The efforescence is avoided by maintaining the water table sufficiently below the roots.

⇒ Hence all the measures which were suggested for Preventing water logging hold good for preventing salnity of lands.

⇒ An efficient drainage (surface and subsurface) must be provided to lower the water table in saline soils.

(ii) Leaching:

⇒ In this process:

* The land is flooded with water.
* Alkaline Salts will be dissolved in water.
* Percolation to the ground water.
* Drained by Subsurface drains

⇒ High Salt resistant crops like rice are grown on leached Soil/Land for 1 or 2 seasons.

⇒ Then ordinary crops like wheat or cotton are grown

⇒ Then the land is said to have reclaimed.

⇒ when Sodium carbonate is present in the Soil, gypsum is added before leaching.

⇒ Sodium Sulphate is formed which is leached out easily.

⇒ $Na_2CO_3 + CaSO_4 \longrightarrow Na_2SO_4 + CaCO_3$

Question no: 02

Part (a): Explain the procedure of designing of an irrigation canal by Kennedy's theory.

Ans: **Procedure of designing irrigation canal:** The following steps are the procedure of designing irrigation canal:

Step: 01 Assume the trial value of D and put in equation 1 and determine $V_0 = 0.546 m D^{0.64}$.

Step: 02 In Equation ① : $Q = AV$

$A = Q/V$

$A = BD + D^2/2$

$P = B + D5^{1/2}$

⇒ For assumed D determine B

⇒ Find $R = A/P$

Step: 03 Substitute the value of R in equation ② (Kutters and Chezy Equation) to obtain V, which will be the actual velocity for assumed dimensions.

Step: 04 If the velocity worked out from equation (2) agrees with that of obtained with the equation (3) (Kennedeys Equation). Then the assumed depth is correct otherwise repeat the procedure with changed value of D.

Assumptions of Kennedy's Theory:

(i) Vertical component of eddies support the silt particles.

(ii) The silting power of channel depends upon its velocity, which controls the eddies.

(iii) There is no equation for bed slope assessments, so the equation developed by Kutter used to compute bed slope.

(iv) The silt transporting power depends upon its depth.

(v) The silt transporting power of a channel is independent of bed width.

Following data should be known:

When any canal is designed by Kennedy theory then we should know:

1. Design Discharge (Q).
2. Slope (S).
3. Rugosity coefficient: n.
4. C.U.R $= m = V/V_o$.

Question no: 02

Part (b): Design an irrigation channel by Kennedy's theory to carry a discharge of 30cumecs with cvr(m) of 1 and N as 0.0225 and bed slope of 1 in 5000 Assume the depth (D) as 2.3m.

Given Data:

Discharge (Q) = 30cumecs

CVR (m) = 1

N = 0.0225

Bed Slope = 1 in 5000.

Depth(D) = 2.3m

Required: Design of Irrigation channel by Kenedy's Theory

Solution: Finding velocity:

By formula $V_K = 0.546 m D^{0.64}$

$V_K = 0.546 (1)(2.3)^{0.64}$

$V_K = 0.930m$

⇒ **Now Area of Canal:**

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

$A = \frac{30}{0.930}$

$A = 32.25m^2$

⇒ **Wetted Perimeter:**

$$P = B + \sqrt{5}\, D \Rightarrow = 12.87 + \sqrt{5}\,(2.3)$$

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

⇒ **Hydraulic Radius:**

$$R = A/P \Rightarrow = 32.25/18.01$$

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

⇒ **mean velocity from Chezy Equation:**

$$V_C = C\,(RS)^{1/2}$$

where
$$C = \frac{\frac{1}{n} + \left(23 + \frac{0.00155}{S}\right)}{1 + \left(23 + \frac{0.00155}{S}\right)\frac{n}{\sqrt{R}}} \Rightarrow \frac{\frac{1}{0.0225} + \left(23 + \frac{0.00155}{(1/5000)}\right)}{1 + \left(23 + \frac{0.00155}{(1/5000)}\right) \times \left(\frac{0.0225}{\sqrt{1.79}}\right)}$$

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

$$\boxed{C = 49.561}$$

$$V_C = 49.561\,\left(1.79\,(1/5000)\right)^{1/2}$$

$$\boxed{V_C = 0.93\, m}$$

Question no: 03

Part(a) Differentiate between initial regime and final regime in accordance to laceys theory.

Initial Regime	Final Regime
① when only bed slope of channel changes but the cross section remains same then also no silting or scouring take place. But this is rare.	If all the perimeters (perimeter, depth and slope) have equally free to vary and adjust according to discharge and silt grade then the channel is said to have final regime.

Question no:03

Part (b): Design a regime channel by lacey theory for discharge of 30cumecs and mean diameter of silt particle of 0.56mm.

Given Data: Discharge (Q) = 30cumecs

mean dia of silt particle (M) = 0.56mm

Required: Regime channel by lacey theory

Solution:

(i) Mean Velocity:

$$V_m = \left[\frac{Q \cdot f^2}{140}\right]^{1/6} = \left[\frac{30(1.32)^2}{140}\right]^{1/6}$$

$$\boxed{V_m = 0.85 \text{ m/sec}}$$

$$f = 1.76 M^{0.5}$$

$$f = 1.76 * (0.56)^{0.5}$$

$$\boxed{f = 1.32}$$

(ii) Hydraulic Depth:

$$R = 5/2 \left(\frac{V^2}{f}\right) = (5/2)\left(\frac{(0.85)^2}{1.32}\right)$$

$$\boxed{R = 1.36}$$

(iii) value of P:

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

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

Now $P = 4.75\sqrt{30}$

$$\boxed{P = 26.02}$$

$$A = \frac{30}{0.85} \Rightarrow \boxed{A = 35.29 \text{ m}^2}$$

(iv) value of D:

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

$$35.29 = BD + \frac{D^2}{2} \quad \text{—— ①}$$

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

$$26.01 = B + 2.236D$$

$$B = 26.01 - 2.236D \quad \text{—— ②}$$

Put equ ② in equ ①

$$35.29 = (26.01 - 2.236D)D + \frac{D^2}{2}$$

$$35.29 = 26.01D - 2.36D^2 + \frac{D^2}{2}$$

$$35.29 = 26.01D - 1.736D^2$$

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

a = -1.736 | b = 26.01 | c = -35.54

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

D = 1.52 ⇒ Putting in Equation = 02

⇒ $B = 26.01 - 2.236(D)$

B = 22.611

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

$$S = \frac{(1.3)^{5/3}}{(3340)(30)^{1/6}}$$

S = 0.000269

Question no: 04

Part (a): Explain the components of headworks with neat diagram.

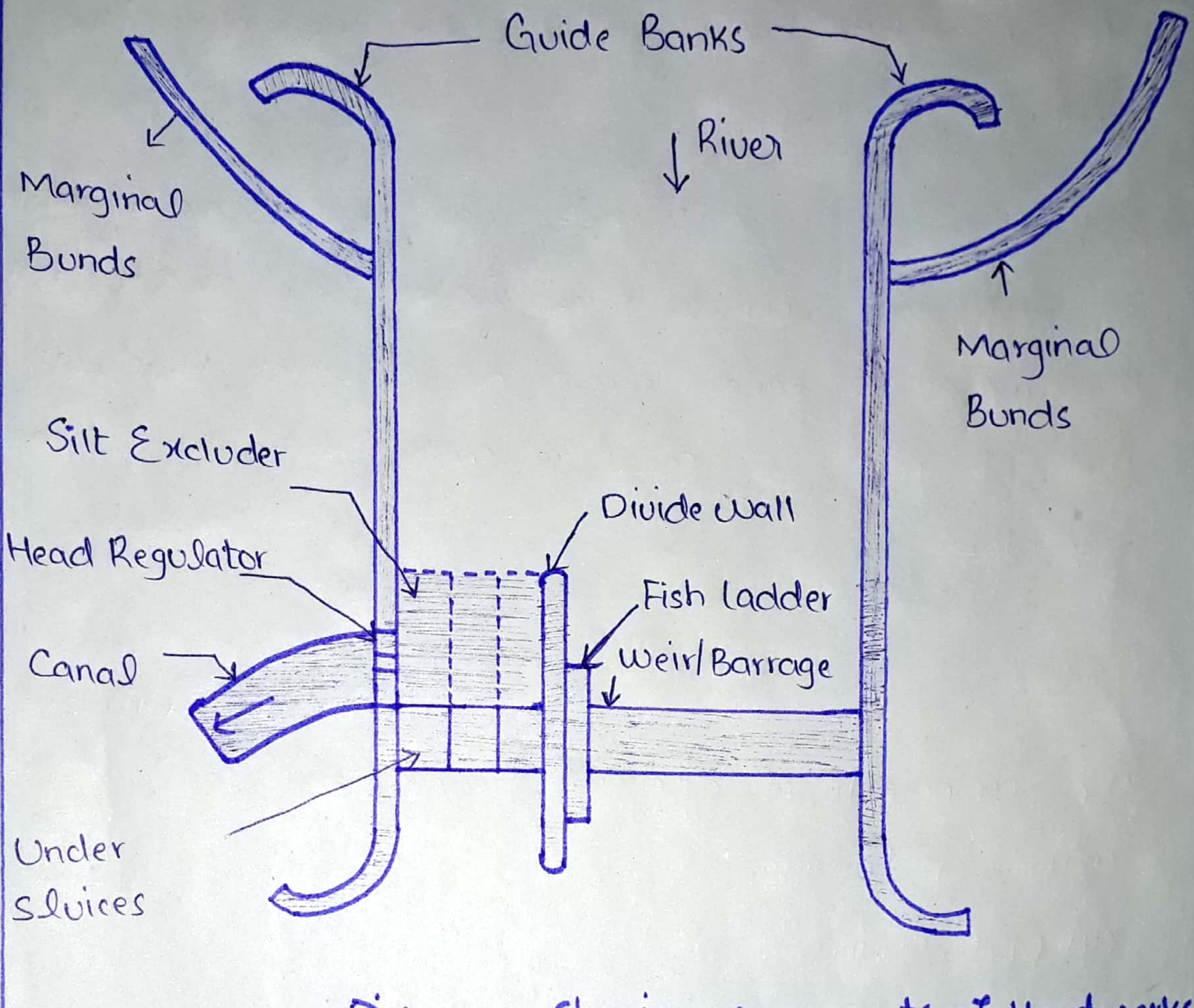


Diagram showing components of Headworks

Head works:

⇒ Any hydraulic Structure which supplies water to the off-talcing canal is called Headwork.

⇒ Two Categories of Head works:
(i) Storage Headwork
(ii) Diversion Headwork.

(i) **Storage Headworks:** Dam is across constructed a river to form storage reservoir, known as Storage head works. water is supplied to canals from this reservoir through canal regulator. These serves for multipurpose functions like hydro-electric power generation, flood control, fishery.

(ii) **Diversion Headworks:** Weir/barrage is constructed accross a perennial river to raise water level and to divert the water to canal, known as diversion Headwork. flow of water in canal is controlled by canal head regulator.

Components of a diversion headwork: The following are the components of diversion headwork:

(i) weir or barrage,

(ii) Undersluices,

(iii) Divide wall,

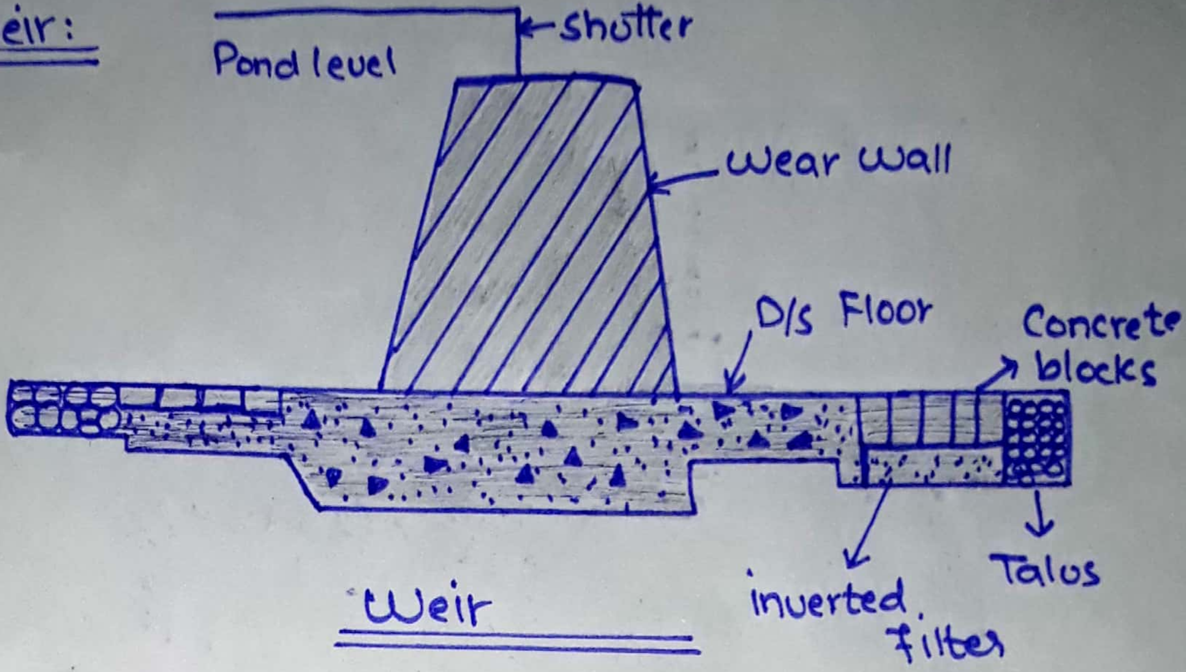
(iv) Fish ladder,

(v) Canal Head Regulator,

(vi) Silt excluders/ Silt prevention devices,

(vii) River training works (Marginal bunds and guide banks).

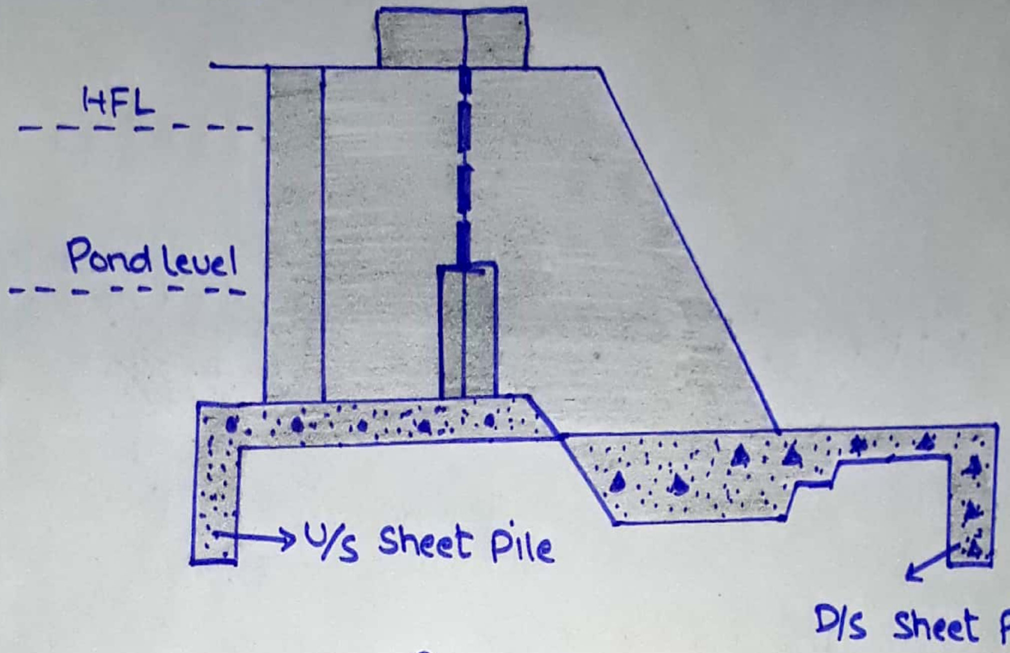
(i) Weir:



Weir

⇒ Normally the water level of any of perreniel river is such that it cannot be diverted to the irragation canal. The bed level of canal may be higher then the existing water level of river. In such cases weir are constructed accross the river to raise the water level. Surplus water pass over the crest of weir. Adjustable shutters are provided on the crest to raise the water level to required height.

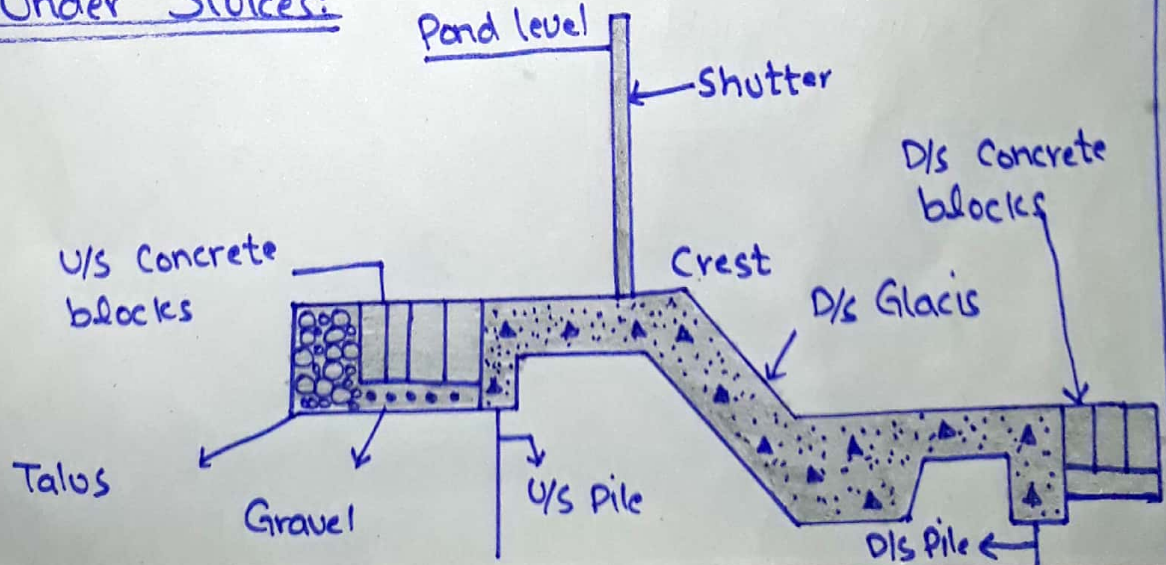
(ii) Barrage:



Barrage

⇒ when the water level on the upstream side of weir is required to be raised to different values at different time, barrage is constructed. Barrage is an arrangement of adjustable gates or shutters at different tires over the weir.

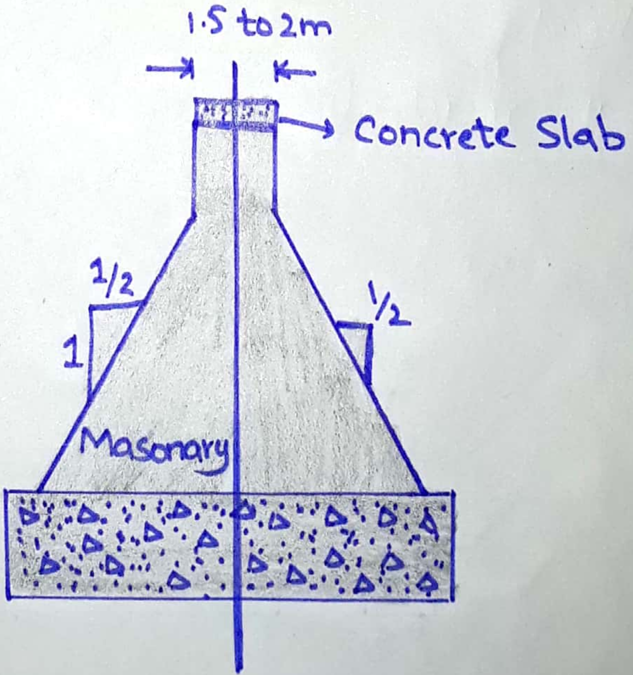
(iii) Under Sluices:



⇒ Also known as Scouring sluices. The under sluices are the openings provided at the base of weir or barrage. These openings are paovided with adjustable gates. Normally the gates are kept closed. The suspended silt goes on depositing in front of canal head regulator.

⇒ When the silt deposition becomes appreciable the gates are opened and the deposited silt is loosened with an agitator mounting on a boat. The gates are then closed when muddy water flows towards the downstream through Scouring Sluices.

(iv) Divide wall:



Divide Wall

⇒ The divide wall is a long wall constructed at right angles in the weir or barrage, it maybe constructed with stone masonary or cement concrete. on the up-Stream Side the wall is extendeud to the canal head coverment and on the downstream side, it is extended upto the launching apron.

⇒ The functions of it are as follows:

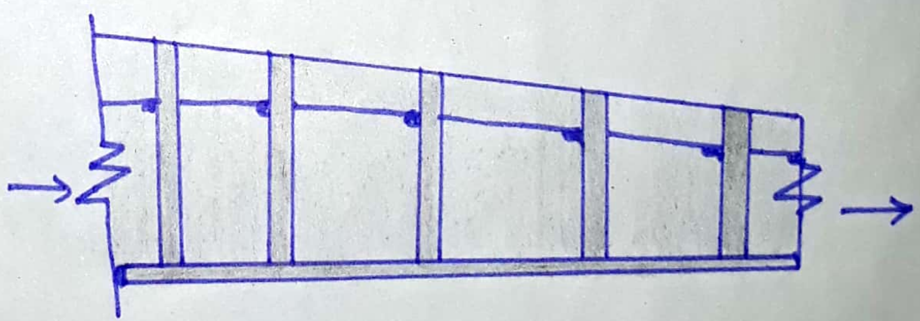
(i) To form a still water pocket infront of Canal head

(ii) It controls the eddy current or cross current in front of Canal head.

(iii) it provide a straight approach infront of canal head.

(iv) It resist the overturning effect on the weir.

(v) Fish ladder:

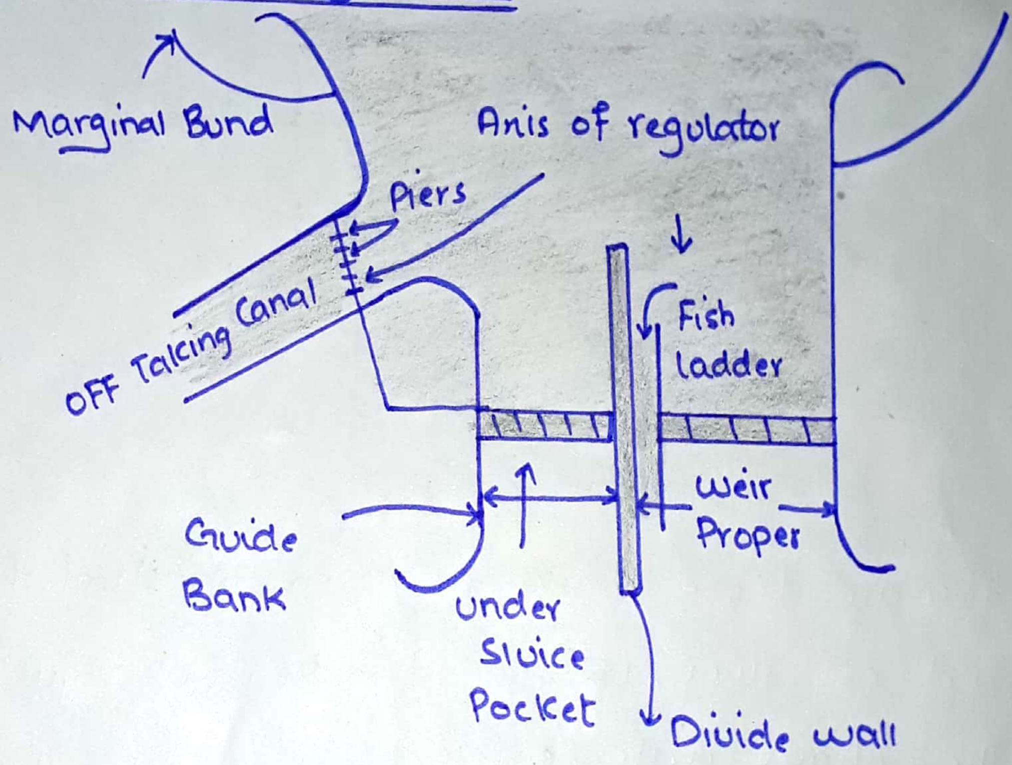


Fish ladder

⇒ The fish ladder is provided just by the side of divide wall for free movement of fishes. This movement is essential for their survival. Due to construction of weir or barrage, this movement gets obstructed and is detrimental to the fishes.

⇒ In the fish ladder, the fable walls are constructed in a zigzag manner, so that the velocity of flow within the ladder doesnt exceed 3m/sec.

(vi) Canal head regulator:

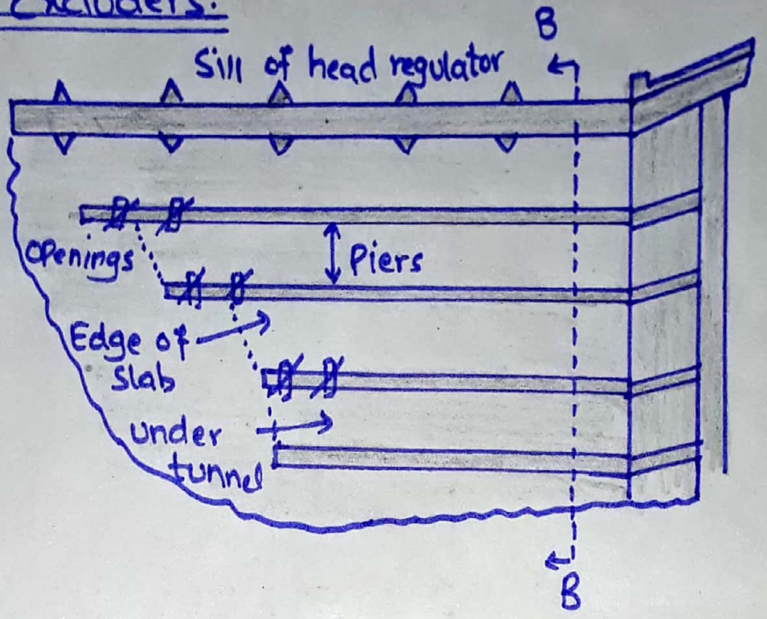


Canal head regulator

⇒ A structure which is constructed at the head of Canal to regulate flow of water is known as Canal head regulator. It consists of a number of Piers. The piers consist the number of tiers on which the adjustable gates are placed.

⇒ Its function is to regulate supply of water entering the Canal. It controls the entry of silt in the canal, and prevent river floods from entering

(vii) Silt Excluders:



Silt Excluder

⇒ These are those works which are constructed on bed of river, upstream the head of regulator. The clearer water enters the head regulator and silted water enters the silt excluders.

(viii) River Training works:

These works are required near the weir site in order to ensure a smooth and an axial flow of water and thus to prevent the river from outflanking the works due to change in its course.

(a) Guide Banks (b) Marginal bunds © Spurs.

Question no: 04

Part (b) Explain the functions of Head regulators.

Functions of Head Regulators: The following are the functions of Head Regulators:

1. It regulates the water supply in Canals.
2. It Controlls the entry of Silt into Canals.
3. It raises the water level on its upstream Side.
4. It Creates a Small Pond (not reservoir) on its upstream and provides some pondage.
5. It helps in Controlling fluctuations of water level in river during different seasons.