

NAME

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SUBMITTED TO

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SUBJECT

IRRIGATION ENGINEERING

ID #

7836

SECTION

B

MODULE

6th

DATE

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1. a) Explain anti water-logging measures.

Ans: Following are the anti water-logging measures:

i- LINING OF CANALS & WATER COURSES:

- Lining of canals makes the water align through the proper channel reducing major losses to greater extent.
- It also reduces seepage of water.

ii- REDUCING INTENSITY OF IRRIGATION:

- Small portion of land should receive canal water in one particular season.
- The remaining areas of land can receive water in next seasons by crop rotation.

iii- INTRODUCTION TO CROP ROTATION:

- High water requiring crop should be followed by one requiring less water and then by one requiring almost no water.

Example: Rice followed by wheat and then by cotton.

iv- OPTIMUM USE OF WATER:

- Proper amount of water gives good results; less or more water affects the yield. Cultivators should be educated so that there is optimum use of water.
- Revenue should be charged on the basis of quantity of water rather than area of land.

v- IMPROVING NATURAL DRAINAGE OF AREA:

- Water should not be allowed to stay in one area.
- Natural flow is provided by bush and jungle cutting.

vi- PUMPING OR TUBEWELLS:

- Lift irrigation should be introduced to use ground water.
- Canal irrigation may be substituted by tube well irrigation.

vii ADAPTION OF SPRINKLER METHOD OF IRRIGATION:

- There should be no percolation losses from water courses.
- Only determined amount of water is supplied to land.

b- Differentiate between saline and alkaline soils.

SALINE SOIL:

- Ans:
- By principle of osmosis, pure water from roots flow outwards in a plant die due to lack of water, such soil is unproductive and is called saline soil.

- Saline soil appearance is as a black crusty core over the surface of earth.

ALKALINE SOIL:

- If the salt efflorescence continues for a longer period, a base exchange reaction with clay takes place thus sodiumizing the clay, making it impermeable, illaerated & highly unproductive, such soil are called alkaline soils.

- It is white in appearance as white patches appear over earth's surface.

c. How do you reclaim salt affected lands?

Ans: Following are the major aspects to reclaim salt affected lands:

- Maintain the water table sufficiently below the roots.
- An efficient drainage (surface & subsurface) must be provided to lower the water table in saline soils.
- The practice of crop reversal is necessary to reduce the establishment of salt or efflorescence.
- Land should be flooded with water so that alkaline salts will be dissolved in water.
- High salt resistant crops like rice are grown on leached land for 1 or 2 seasons.

2-a Explain the procedure of designing of an irrigation canal by Kennedy's theory?

Ans: Following are the steps required for designing an irrigation canal using Kennedy's theory:

Step 1: Assume the trial value of D and put it in equation (1) and determine

$$V_0 = 0.546 m D^{0.64}$$

Step 2: As equation (1) is $Q = AV$

$$\text{Thus } A = Q/V$$

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

$$P = B + D 5^{1/2}$$

For assumed D determine B ; Find $R = A/P$

Step 03:

Substitute the value of R in Kutter's and Chazy's equation, to obtain V which will be the actual velocity for assumed dimensions.

Step 04:

If the velocity worked out from Kutter's and Chazy's equation agrees with that of obtained with the Kennedy's equation then the assumed depth is correct. Otherwise repeat the procedure with changed value of D .

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

Sol:

Given data:

$$D = 2.3 \text{ m}$$

$$Q = 30 \text{ cumec}$$

$$C.V.R = m = 1$$

$$N = 0.0225$$

$$S = 1/5000 = 0.0002$$

As we know

$$Q = AV$$

$$A = \frac{Q}{V} = \frac{30}{V} \quad \text{--- (1)}$$

Thus, using formula to compute "V"

$$V_0 = 0.546 m D^{0.64}$$

$$V_0 = 0.546 (1) (2.3)^{0.64}$$

$$V_0 = 0.935 \text{ m/s}$$

Put this value in eqn (1)

$$A = \frac{30}{0.935} = 32.01 \text{ m}^2$$

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

$$32.01 = B(2.3)^2 + \frac{2.3^2}{2}$$

$$\boxed{B = 12.77 \text{ m}}$$

put the value in below eqn:

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

$$P = 12.77 + 2.3(\sqrt{5})$$

$$\boxed{P = 17.9 \text{ m}}$$

Now; $R = \frac{A}{P} = \frac{32.01}{17.9} = 1.76$

Substituting the value of "R" in kutter's and Chazy's equation

$$V = C(RS)^{1/2} \text{ --- (a)}$$

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

$$C = \frac{1}{\frac{1}{1} + \left(23 + \frac{0.00155}{0.0002}\right)} = 49.526$$

$$\frac{1}{1 + \left(23 + \frac{0.00155}{0.0002}\right) \frac{1}{\sqrt{1.76}}}$$

put the value in eqn (a)

$$V = 49.526 (1.76 \times 0.0002)^{1/2}$$

$$\boxed{V = 0.93 \text{ m/s}}$$

This is equal to V_0 thus no more trials required.

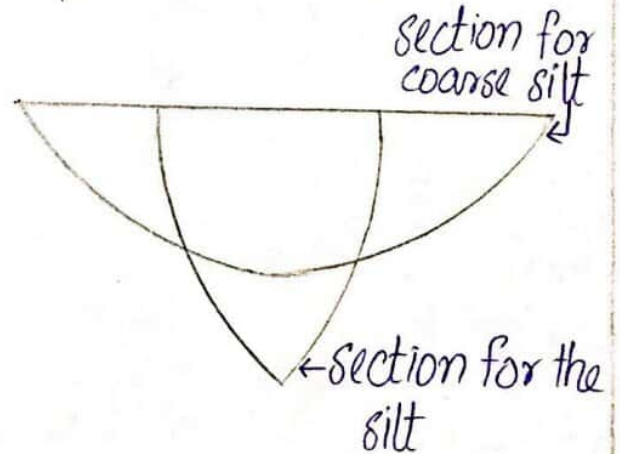
3. Q. Differentiate between initial regime and final regime in accordance to Lacey's theory.

INITIAL REGIME

- When only bed slope of channel changes but the cross section remains same there will be no silting and scouring.
- cross-section or wetted perimeter remains unaffected.
- It is a quick process and occurs within short span of time.

FINAL REGIME

- If all the parameters (perimeter, depth and slope) have equally free to vary and adjust according to discharge and silt grades then the channel is said to have final regime.
- In final regime the cross section assumes semi-ellipse shape.



b. Design a regime channel by Lacey's theory for discharge of 30 cumecs and mean dia of silt particle of 0.56mm.

Sol: Given data $Q = 30 \text{ cumec}$, $d = 0.56 \text{ mm} = (M)$

By formula; silt factor = $f = 1.76 \times M^{0.5} = 1.76 (0.56)^{0.5}$

$$f = 1.3$$

$$\rightarrow V_m = \left[\frac{Qf^2}{140} \right]^{1/6} = \left[\frac{30 \times (1.3)^2}{140} \right]^{1/6} \Rightarrow \boxed{V_m = 0.844 \text{ m/s}}$$

$$\rightarrow Q = AV \quad ; \quad A = \frac{Q}{V} = \frac{30}{0.844} \Rightarrow \boxed{A = 35.54 \text{ m}^2}$$

$$\rightarrow P = 4.75 \sqrt{Q} = 4.75 \sqrt{30} \Rightarrow \boxed{P = 26.01}$$

$$\rightarrow R = \frac{5}{2} \times \frac{V^2}{f} = \frac{5}{2} \times \frac{0.844^2}{1.3} \Rightarrow \boxed{R = 1.36 \text{ mm}}$$

As we know

$$\star A = BD + \frac{D^2}{2} \quad ; \quad 35.54 = BD + \frac{D^2}{2} \quad \text{--- (1)}$$

$$\star P = B + D\sqrt{5} \quad ; \quad 26.01 = B + 2.236D \quad \text{--- (2)}$$

$$\text{Thus } B = 26.01 - 2.236D \quad \text{--- (3)}$$

put eqn (3) in eqn (1)

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

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

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

$$1.736D^2 - 26.01D + 35.54 = 0 \quad (\text{Using quadratic formula})$$

$$\Rightarrow x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} = \frac{-(-26.01) \pm \sqrt{(26.01)^2 - 4(1.736)(35.54)}}{2(-1.736)}$$

$$\boxed{D = 1.52} \quad \text{put in eqn (3) we get}$$

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

$$\boxed{B = 22.611 \text{ mm}}$$

$$\rightarrow \text{Now, } S = \frac{f^{5/3}}{3340 Q^{1/6}} = \frac{(1.3)^{5/3}}{3340 (30)^{1/6}} \Rightarrow \boxed{S = 0.00027}$$

4- a Explain the components of headworks with neat diagram.

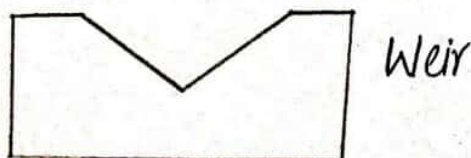
Following are the components of headworks:

- Weir or barrage
- Undersluices
- Divide wall
- Fish ladder
- Canal head regulator
- Silt excluders / Silt prevention devices.
- River training works.

1 WEIR AND BARRAGE:

Normally the water level of any perennial river is such that it cannot be diverted to the irrigation canal. The bed level of canal may be higher than the existing water level of the river. In such cases weir is constructed across 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 some required height.

- When the water level on the upstream side of the weir is required to be raised to different levels at different time, barrage is constructed. Barrage is an arrangement of adjustable gates at different times over the weir.



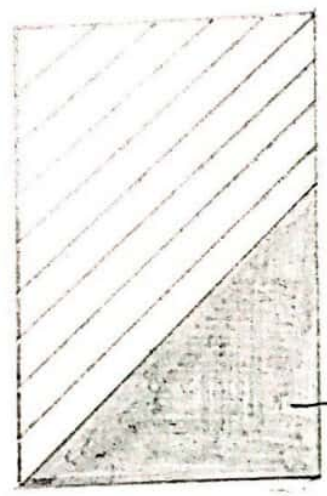
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UNDER SLUICES:

It is also known as scouring sluices. The under sluices are the openings provided at the base of the 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.

- When the silt deposition becomes appreciable the gates are opened and the deposited silt is loosened with an agitator mounting on a boat. The muddy water flows towards the downstream through the scouring sluices. The gates are then closed. But, at the period of flood, the gates are kept opened.



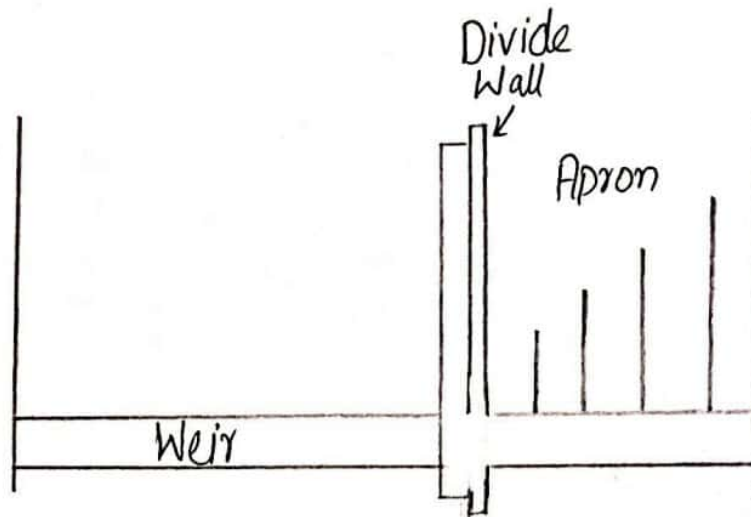
→ Under sluice gate

→ Water passage.

3.

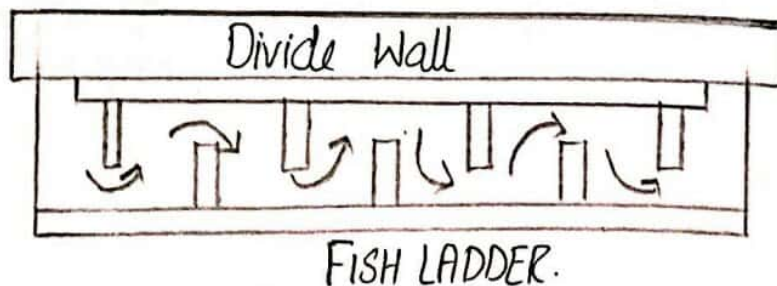
DIVIDE WALL:

The divide wall is a long wall constructed at right angles in the weir or barrage, it may be constructed with stone masonry or cement concrete. On the upstream side the wall is extended just to cover the canal head regulator and on the downstream side, it is extended up to the launching apron.



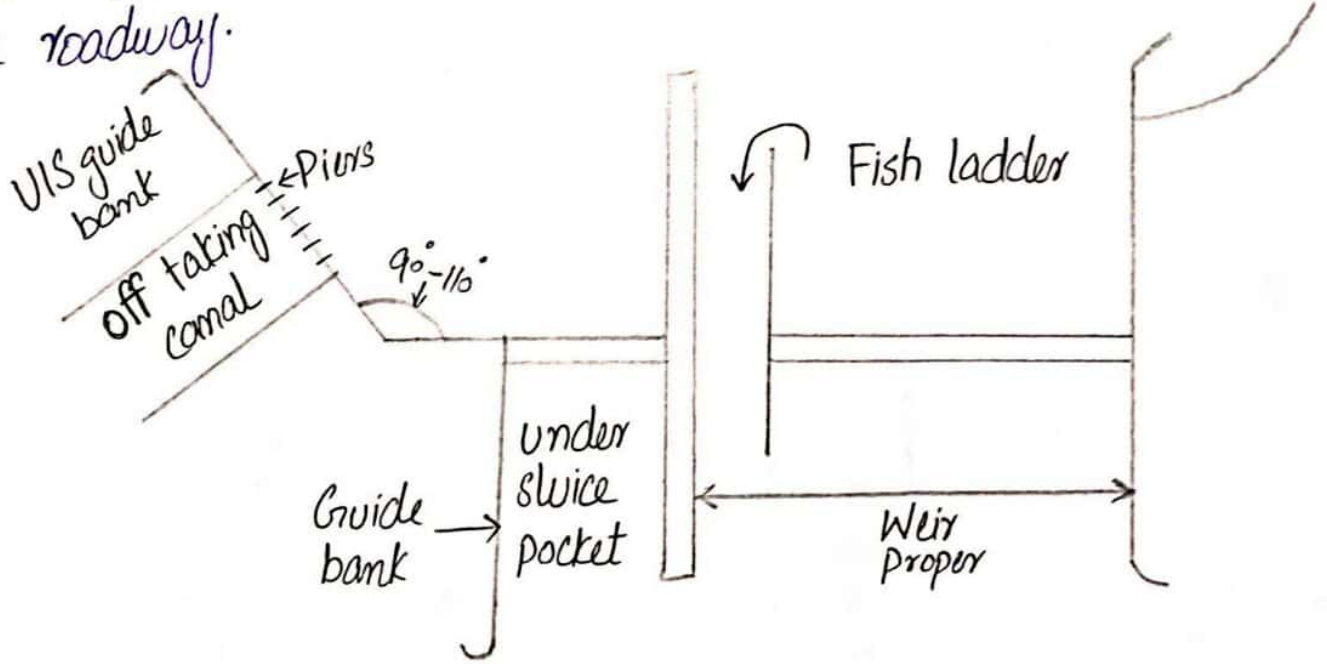
4- FISH LADDER:

- It is provided just by side of the divide wall for the free movement of fishes. Rivers are important source of fishes. The tendency of fish is to move from upstream to downstream in winters and from downstream to upstream in monsoons. This movement is essential for their survival. Due to construction of weir or barrage, this movement gets obstructed, and it is detrimental to fishes.
- In the fish ladder, the fable walls are constructed in a zigzag manner so that the velocity of flow within the ladder does not exceed 3m/sec .
- The width, length, height of the fish ladder depend on the nature of the river and the type of the weir or barrage.



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 consists of number of piers which divide the total width of the canal into a number of spans which are known as bays. The piers consist of number tiers on which the adjustable gates are placed.
- The gates are operated form the top by suitable mechanical device. A platform is provided on the top of the piers for the facility of operating the gates. Again some piers are constructed on the down stream side of the canal head to support the roadway.



SILT REGULATION WORKS:

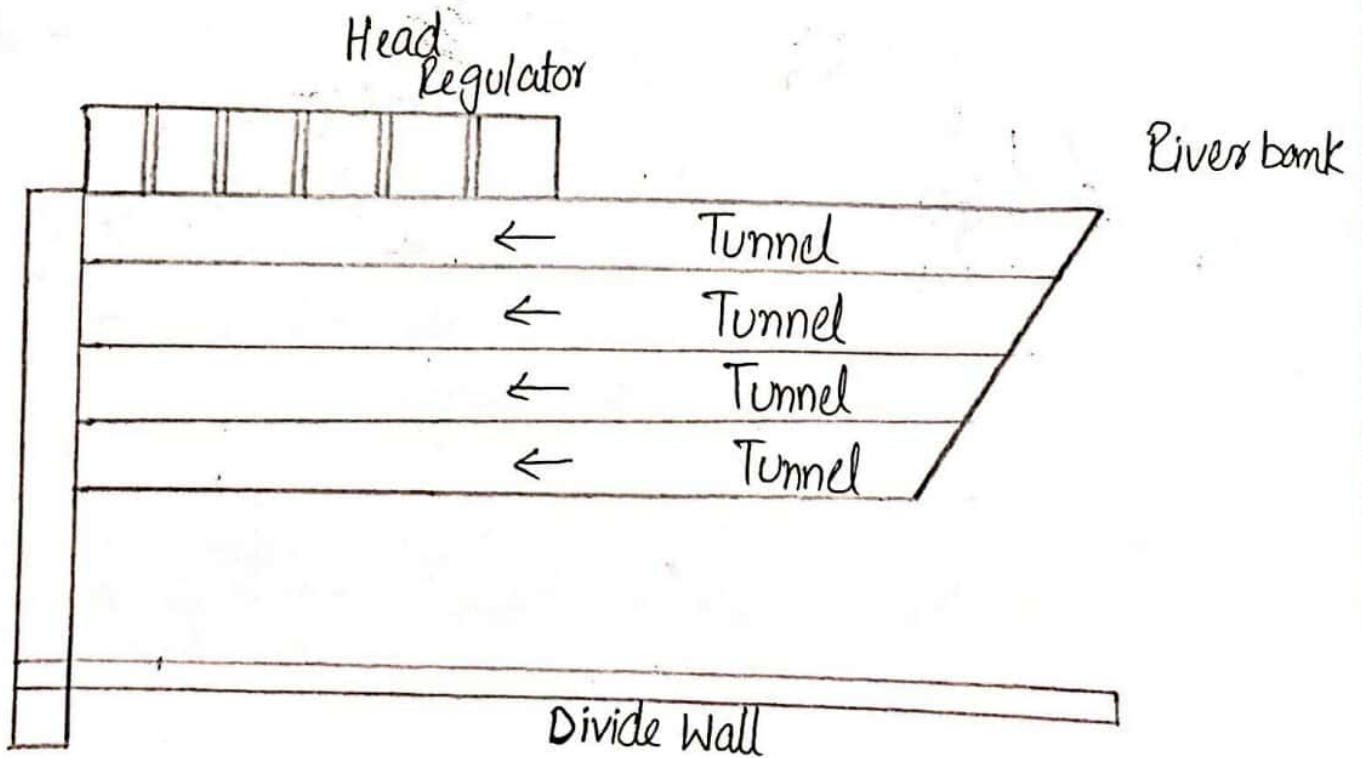
- The entry of silt into a canal, which takes off from a head works, can be reduced by constructed certain special works, called silt control works. These work may be classified into the following two types: (a) Silt excluders, (b) Silt Ejectors.

a- SILT EXCLUDERS:

Silt excluders are those works which are constructed on the bed of the river, upstream of the head regulator. The cleaner water enters the head regulator and silted water enters the silt excluder. In this type of works, the silt is, therefore removed from the water before it enters the canal.

b- SILT EJECTORS:

Silt ejectors are also called silt extractors, are those devices which extract the silt from the canal water after the silted water has travelled a certain distance in the off take canal. These works are constructed on the bed of the canal, and little distance downstream from the head regulator.



SILT EXCLUDER

7. RIVER TRAINING WORKS:

River training 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 the outflanking the works due to a change in its course. Their river training works required on a canal headwork are a) Guide banks, b) Marginal bunds, c) Spurs/groynes.

4. b) What are the functions of head regulator?

Ans. The major function is to regulate the supply of water entering the canal. It controls the entry of silt in the canal.

- It prevents the river floods from entering the canal.
- It regulates / indicate the discharge passed into the canal from design discharge formula.