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Subject Irrigation

Final term paper

QUESTION NO (1)

(a) ANTI WATER LOGGING MEASURES:

→ Quantity of water into soil below is reduced.

→ Inflow into underground reservoir is reduced and outflow should be increased.

→ METHODS OF CONTROL OF WATER LOGGING:

(i) LINING OF CANALS AND WATER COURSES.

→ It reduces seepage of water.

(ii) REDUCING INTENSITY OF IRRIGATION:-

→ Only small portion of land should receive canal water in one particular season.

→ Remaing areas can receive water in next season by rotation.

(iii) BY INTRODUCING CROP ROTATION:-

→ High water 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.

(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.

(5) IMPROVING NATURAL DRAINAGE OF AREA:-

→ Water should not be allowed to stay in one area.

→ Natural flow - is provided by bush and jungle cutting.

(6) PUMPING OR TUBEWELLS OR VERTICAL DRAINAGE:-

Lift irrigation should be introduced to use GW. Canal irrigation may be subsitituted by tube well irrigation.

QUESTION 1 (B)

→ Differentiate between soils:

SALINE SOILS

Definition:-

① Saline soils are the soils that have a pH in b/w 7 and 8.5 and an exchangeable sodium percentage below 15%.

PH:- Less than 8.5

Exchangeable sodium %

Less than 15

ELECTRICAL CONDUCTIVITY:-

4 or more mmhos/cm

MOST COMMON IONS:-

→ Mainly sodium chloride and sodium sulphate. Also Calcium chloride Calcium sulfate, Calcium bicarbonate. Magnesium sulfate and Magnesium bicarbonate in small amounts.

→ ORGANIC MATTER CONTENT:-

→ HIGH

→ COLOUR OF THE SOIL:-

→ white or light gray

QUESTION 1 (C) (4)

→ How do you reclaim salt affected lands?

ANSWER:-

How to avoid efflorescence?

→ By maintaining the water table sufficiently below the roots.

→ Hence all the measures which were suggested for preventing water logging hold good for preventing salinity of lands.

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

QUESTION (2) (a)

→ Designing of an irrigation canal by Kennedy's theory:.

⇒ ASSUMPTIONS:.

① → vertical component of eddies support the silt particles.

② → The silting power of a channel depends upon its velocity, which controls the eddies.

③ The silt transporting power depends upon its depth.

④ The silt transporting power of a channel is independent of bed width.

KENNEDY'S THEORY:-

→ R.G. Kennedy studied straight reaches of upper Bari Doab which are stable for 30 years.

$$V_o = CD^n$$

V_o = Critical velocity (non-silting or non-scouring).

C = Constant depends upon quantity of silt.

→ KENNEDY'S PROCEDURE FOR CANAL DESIGN:

Step 1:-

Assume the trial value of D and put in eqn and determine

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

Eqn ⇒ $Q = AV$

Step 2:-

$$A = Q/V$$

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

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

For assumed D determine B.

Find $R = A/P$

STEP 3:

Subsitute the value of R in eqn 2 (kutters and clazys Eqn) to obtain V which will be the actual velocity for assumed dimensions.

STEP 4:- If the velocity worked out from Eqn 2. agrees with that of obtained with Eqn 3 (kennedy's). Then the assumed depth is correct. Otherwise repeat the procedure with changed value of D.

(7)

Question No (2)

(b)

Given Data:-

$Q = 30\ m^3/sec$

$C.V.R = m = 1$

$N = 0.0225$

$S = 1/5000$

Solution:

First assume the depth $d = 2.4\ m$.

Step of trail 1:

$V_0 = 0.55\ mD^{0.64}$

$V_0 = 0.55 \times 1 \times (2.4)^{0.64}$

$V_0 = 0.963$

Step 2:

$Q = AV$

$A = Q/V$

$A = 30/0.963$

$\boxed{A = 31.153\ m^2}$

$A = BD + D^2/2$

$31.153 = B \times 2.4 + \frac{(2.4)^2}{2}$

$\boxed{B = 11.78\ m}$

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

$P = 11.78 + 2.4\sqrt{5}$

$\boxed{P = 17.146\ m}$

$R = \frac{A}{P} = \frac{31.153}{17.146}$

$\boxed{R = 1.82}$

(Kutter 4 chezy Eq).

Step 3 $V = C(\sqrt{RS})$

$$C = \frac{\frac{1}{0.0225} + \left(23 + \frac{0.00155}{0.0002}\right)}{1 + \left(23 + \frac{0.00155}{0.0002}\right) \times \frac{0.00251}{\sqrt{1.82}}}$$

$C = \frac{75.194}{1.513}$

$\boxed{C = 49.703}$

$V = c(\sqrt{RS})$

$V = 49.703 \times \sqrt{1.82 \times 0.0002}$

$\boxed{V = 0.948} < \boxed{V = 0.963}$

Then decrease the depth.

$\boxed{d = 2.3\ m}$

TRAIL 2 :-

This 2nd trial is a directly calculated value.

$D = 2.3\,m$

Step 1 :-

$V_0 = 0.55 \times 1 \times (2.3)^{0.64}$

$V_0 = 0.937\ m/sec$

Step 2 :-

$A = Q/V = 30/0.937$

$A = 32.017\,m^2$

$A = BD + D^2/2$

$B = 12.77\,m$

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

$P = 17.913\,m$

Step 3 :-

$C = \frac{75.195}{1.518}$

$C = 49.535$

$R = A/P$

$R = 1.787$

$V = C \times \sqrt{RS}$

$V = 49.535\sqrt{1.787 \times 0.0002}$

$V = 0.93\ m/sec$ which is equal to V_0.

Q3) (a)

Lacey's Theory:-

- According to kennedy, a channel is regime (No silting, No scouring) but according to lacey even though channel with no silting or scouring may actually be not in regime.

Initial Regime:-

- when only bed slope of channel changes but the cross section remains same then also ~~and~~ no silting or scouring takes place But this is rare.

Final Regime:-

- If all the parameters (parimeter, depth and slope) have equally free to vary and and adjust according to discharge and silt grades the the channel is said to have final regime.

Q3 (b)

Given:-

Q, Discharge = 30 m³/sec

Mean dia of silt particles (M) = 0.56 mm

Solution:-

Calculate velocity first (mean)

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

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

∵ f = Lacey's silt factor

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

$= 1.76(0.56)^{0.5}$

$f = 1.32$

=> Now finding value of "P"

By formula

First find Area

By discharge formula

$Q = AV$

$$\Rightarrow A = Q/V = \frac{30}{0.85} \Rightarrow \boxed{A = 35.29\, m^3}$$

Now

$P = 4.75\sqrt{Q}$

$= 4.75 \times \sqrt{30}$ → $\boxed{P = 26.02}$

Now calculate "S"

By using formula

$$S = \frac{f^{5/3}}{3340\, Q^{1/6}} = \frac{(1.32)^{5/3}}{3340 \times (30)^{1/6}}$$

$$\Rightarrow \boxed{S = 0.000269}$$

Dimensions Calculations:-

By formula

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

$35.29 = BD + \frac{D^2}{2}$ — (1)

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

$26.01 = B + 2.236D$

$B = 26.01 - 2.236D$ — (2)

Put eq (2) in (1)

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

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

$35.29 = 26.01D - 2.236D^2 + 0.5D^2$

$35.29 = 26.01D - 1.736D^2$

$\underbrace{-1.736D^2}_{a} + \underbrace{26.01D}_{b} - \underbrace{35.29}_{c} = 0$

Quadratic Equation:-

$$D = \frac{-(26.01) \sqrt{(26.01)^2 - 4(-1.736)(-35.29)}}{2(-1.736)}$$

$D = 1.51m$ → Put in eq (2)

$\Rightarrow$ $B = 26.01 - 2.236(1.51)$

$\Rightarrow$ $\boxed{B = 22.63m}$

Question 4 (a):-

⇒ COMPONENTS OF A 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 OR BARRAGE:-

→ Normally the water level of any perennial river is such that it cannot be diverted to the irrigation canal.

→ Bed level of the canal maybe higher than the existing water level of river.

→ In such cases weir or barrages is constructed across the river to raise the water level.

→ when the level of water on the upstream side of the weir is required to be raised to different levels at different time, a barrage is constructed.

→ UNDER SLUICES:- (scouring sluices)

→ Under sluices are the openings provided at the base of weir or barrage.

→ These openings are provided with adjustable gates and the gates are usually kept closed.

→ The suspended slit goes on depositing in front of the canal head regulator

→ When the slit deposition becomes appreciable the gates are opened and deposited silt is loosened with an agitator mounting on a boat.

→ DIVIDE WALL:-

The divide wall is a long wall constructed at right angles in the weir or barrage and may be constructed with stone masonry or cement concrete.

Functions:-

→ To form a still water pocket in front of the canal.

→ It controls the eddy current or cross current in front of the canal head.

→ provides a straight approach in front of the canal head.

→ FISH LADDER :-

Fish ladder is provided just by the side of the divide wall for 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 moonsoon.

Functions:

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

→ 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.

→ Consists of number of piers which divide the total width of the canal into number of spans which are known as bays.

→ FUNCTIONS OF CANAL HEAD Regulator:-

→ Regulate the supply of water entering the canal.

→ Controls the entry of silt in the canal.

→ prevents the river-floods from entering the canal.

→ Silt regulation works:-

→ Entry of silt into a canel, which takes off from a head works, can be reduced by constructed certain special works.

Two Types.

(a) Silt excluders

(b) Silt Ejectors.

→ RIVER TRAINING WORKS:-

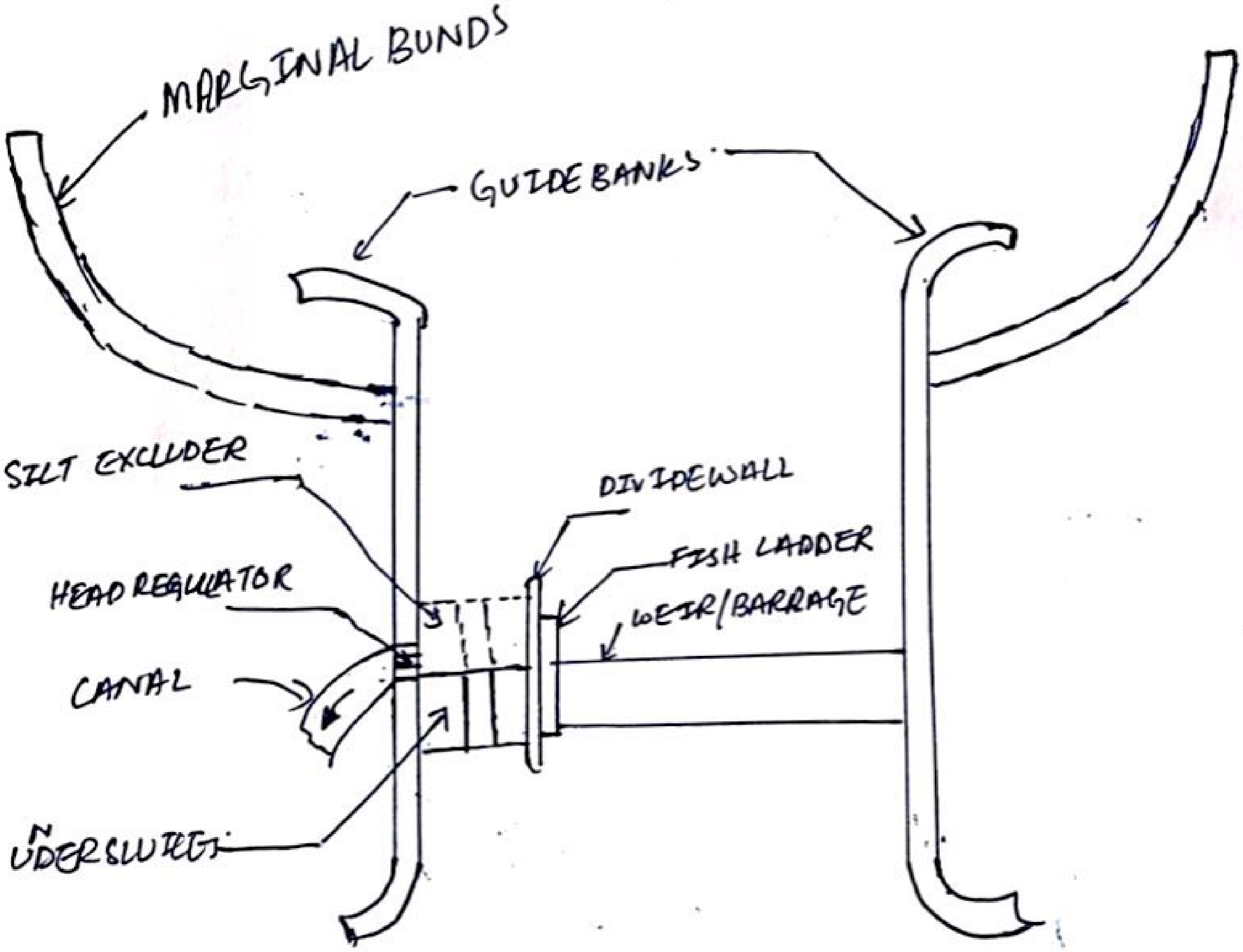
→ River training works are required near the weir site in order to ensure a smooth and axial flow of water, and thus to prevent the river from outflanking the works due to a change in its course.

River training works required.

(a) Guide banks (b) Marginal bunds

(c) Spurs or groynes.

HEADWORK DIAGRAM:-



Q4 (b)

What are the functions of Head regulators?

Ans Head Regulator:-

Regulators constructed at the off taking point are called head regulators when it is constructed at the head of main canal it is known as canal head regulator, And when it is constructed at the head of distributary, it is called distributary head regulator.

Function:-

=> To control the entry of water either from reservoir or from the main canal

=> To control the entry of silt into off taking the main canal.

=> To serve as a meter for measuring discharge of water.