IQRA NATIONAL UNIVERSITY PESHAWAR

DEPARTMENT OF CIVIL ENGINEERING

SUBJECT: IRRIGATION ENGINEERING

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Q.NO (01) A

ANSWER:

WATER LOGGING

When the conditions are so created that the crop root-zone gets deprived of proper aeration due to the presence of excessive moisture or water content, the tract is said to be waterlogged. To create such conditions it is not always necessary that under groundwater table should enter the crop root-zone.

The water-logging may be defined as rendering the soil unproductive and infertile due to excessive moisture and creation of anaerobic conditions.

CAUSES OF WATER-LOGGING:

After studying the phenomenon of water-logging in the light of hydrologic equation main factors which help in raising the water-table may be recognized correctly.

They are:

i. Inadequate drainage of over-land run-off increases the rate of percolation and in turn helps in raising the water table.

ii. The water from rivers may infiltrate into the soil.

iii. Seepage of water from earthen canals also adds significant quantity of water to the underground reservoir continuously.

iv. Sometimes subsoil does not permit free flow of subsoil water which may accentuate the process of raising the water table.

v. Irrigation water is used to flood the fields. If it is used in excess it may help appreciably in raising the water table. Good drainage facility is very essential.

vi. Unscientific agricultural practices are responsible for water logging and salinity

vii. According to 48% of the population, seepage from canals causes water logging and salinity

viii. Poor irrigation

Q.NO (01) B

ANSWER:

EFFLORESCENCE

Efflorescence is a crystalline deposit of salts that can form when water is present in or on brick, concrete, stone, stucco or other building surfaces. It has a white or grayish tint and consists of salt deposits left behind when water evaporates. In addition, efflorescence can appear as a powdery substance on floors and walls and requires special care to treat

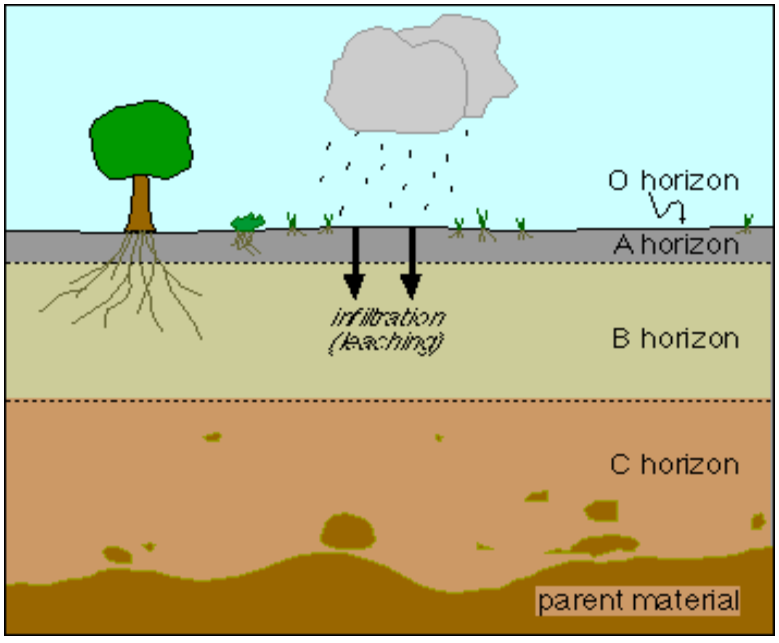
The word efflorescence means "to flower out" in French, but this flowering leaves an unattractive residue behind. It sparkles. It's white, sometimes with a grayish tint, and flakes off the masonry surface.

LEACHING PROCESS

Leaching is the process by which constituents of a solid material are released into a contacting water phase. Although some species may be more of an environmental concern than others, the leaching process is indiscriminant such that all constituents (e.g., major or minor matrix components as well as inorganic, organic and radionuclide contaminants) are released under a common set of chemical phenomena which may include mineral dissolution, desorption and complication, and mass transport processes.

In turn, these phenomena are affected by certain factors that can alter the rate or extent of leaching. Among these factors are:

- Internal chemical and physical reactions
- External stresses from the surrounding environment
- Physical degradation of the solid matrix due to erosion or cracking, and
- Loss of matrix constituents due to the leaching process itself.



Q.NO (02) A

ANSWER:

Design of Irrigation Canals Making Use of the Kennedy Theory:

When an irrigation channel is to be designed by the Kennedy theory it is essential to know FSD (Q), coefficient of rugosity (N), CVR (m), and longitudinal slope of channel (S), beforehand. Then making use of the following three equations section can be designed by trials:

$V = 0.546\ m.\ D^{0.64}$ $Q = A.V$; and $V = C\sqrt{RS}$

The procedure of designing may be outlined in the following steps:

i. Assume the reasonable full supply depth, D.

ii. Using equation (1) find out value of V.

iii. With this value of V, using equation (2) find out A

iv. Assuming side slopes and from the knowledge of A and D find out bed width B.

v. Calculate R which is ratio of area and wetted perimeter.

vi. Using equation (3) find out value of actual velocity V.

When the assumed value of D is correct, the value of V in step (f) will be same as V calculated in step (b), if not assume another suitable value of D and repeat the procedure till both values of velocity come out to be the same.

It may be recognized here that for same values of Q, N and m but with different values of S various channel sections may be designed. It is needless to mention that all of them would not be equally satisfactory. To give some guidance for fixing particular slope (b) . Woods has given a table (Table 1) on the basis of experience in which he gives suitable B/D ratios for various values of Q, S, N, m. Further, by adopting suitable BID ratio labor of making trials can be avoided.

Thus when Q, N, m and BID ratio are given using the above given three formulae viz., Kennedy's equation, continuity equation

The procedure of designing may be outlined in the following steps:

i. Using equation (1) express V in terms of D only.

ii. From given BID ratio and side slopes calculate area A in terms of depth D only (if side slopes are not given take ½: 1 as side slopes for alluvial tract).

iii. Using equation (2) obtain another relation between V and D only.

iv. Solve two equations giving relation between F and D as simultaneous equations and find out the value of D.

v. Calculate value of B from known BID ratio. vi. Calculate V from Kennedy's equation (1).

vii. Using Chezy's equation calculates value of S.

Table.1 Woods Design table for Use in Kennedy Theory

Discharge (m^3/sec)	B/D	B (m)	D (m)	Slope 1 in	Kutter's N	V/V_0	V (m/sec)
0.283	2.9	1.45	0.488	3333	0.0225	0.92	0.344
0.708	3.4	2.21	0.656	3636	0.0225	1.01	0.424
1.415	3.7	3.125	0.839	4000	0.0225	1.00	0.476
2.83	4.2	4.425	1.036	4444	0.0225	1.00	0.555
7.08	4.8	6.705	1.54	4444	0.0225	1.01	0.702
14.15	5.7	9.77	1.725	5000	0.0225	1.01	0.755
28.30	7.6	15.25	1.984	5000	0.0225	1.03	0.882
56.60	11.3	25.48	2.255	5714	0.0225	1.03	0.945
141.50	22.5	56.40	2.50	6666	0.0225	0.98	0.975
283.00	41.0	105.40	2.59	6666	0.0225	1.02	1.01
		110.00	2.68	8000	0.0225	0.98	0.955

Q.NO (02) B

ANSWER:

INTIAL REGIME

When a channel is first put into service, then the channel tries to attain its "intial regime" condition. When the channel is excavated with small width and flatter slope, then the bed slope gets increased due to deposition of sediment, in order to develop increased flow velocity. The increased velocity enables the discharge to pass through the channel having small width.

Here with the increased bed slope the depth of the channel also varies, however the width of the channel does not vary and remains constant. So keeping constant discharge, constant width, constant silt charge and constant silt grade and only by varying bed slope and depth of channel, the channel attains stability, such a condition is known as initial regime condition.

FINAL REGIME

This is the ultimate regime condition attained by the channel when, in addition to varying bed slope and depth of the channel, the width of the channel is also allowed to vary.

What happen exactly is that with the passage of time, the resistance offered by the sides of the channel against erosion comes to an end due to continuous action of water, so the channel adjusts its bed slope, depth and width in order to attain stability. Such a condition is known as final regime condition.

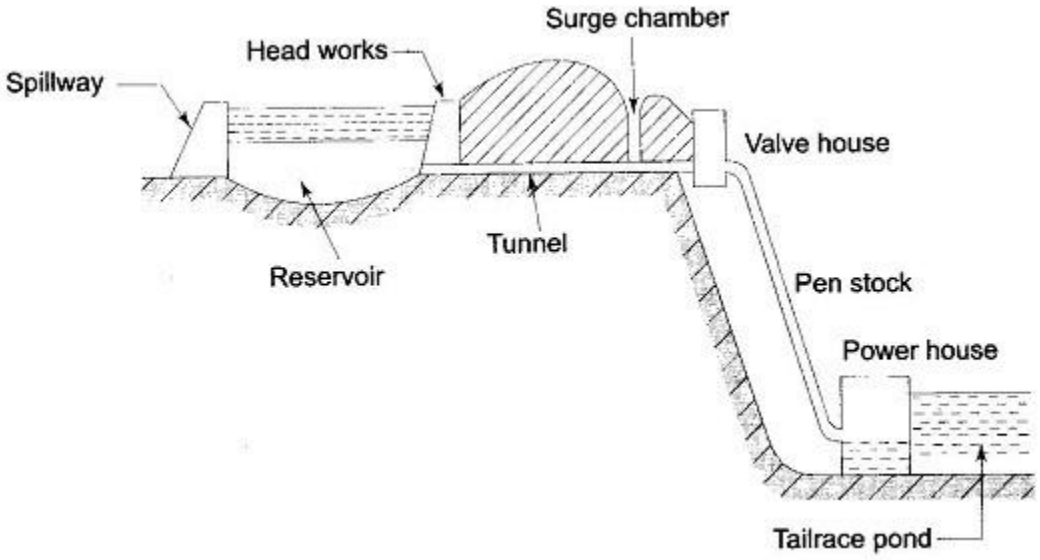
Such a channel where all the parameters such as width, depth and bed slope are allowed to vary freely, has the tendency to attain a semi-elliptical shape. So coarser the silt, flatter would be the semi-ellipse and finer the silt, the shape would be more or less of a semi-circle.

Q.NO (03) A

ANSWER:

STORAGE HEAD WORKS

When dam is constructed across a river to form a storage reservoir, it is known as storage head work.



Various purposes served by Storage head works are as follows:

- It stores water during the period of excess supplies in the river and releases it when demand overtakes the available supplies.
- The storage head works stores water in addition to the diversion into the canal.
- A headwork raises the water level in the river
- It regulates the intake of water into the canal
- It controls the entry of silt into the canal
- A headwork can store water for small periods
- It diverts specified discharge flow downstream the dam.
- A headwork can reduce fluctuations in the level of river supply

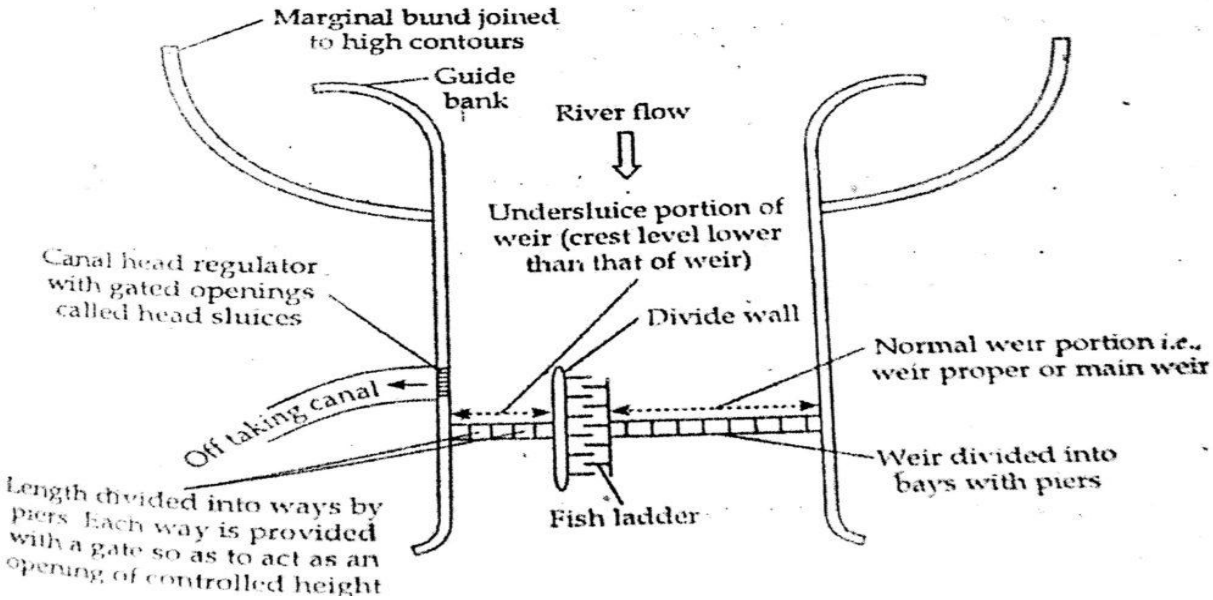
DIVERSION HEAD WORKS

A weir or a barrage is constructed across a river to raise water level and to divert water to a canal is known as a diversion headwork. Diversion head works serve to raise the water level in the river and divert the required quantity into the canal.

The various purposes served by diversion head works are as follows:

- They raises the water level in the river so that the commanded area is increased
- They regulates the supply of water into the canal
- It controls the entry of silt into the canal

- They will provide some storage of water for a short period
- The flow in the canal is controlled by canal head regulator



Diversion Head Work

Q.NO (03) B

ANSWER:

OBJECTIVES OF DIVERSION HEAD WORKS

- To form a storage by constructing dykes (embankments) on both the banks of the river so that water is available throughout the year
- To control the entry of silt into the canal and to control the deposition of silt at the head of the canal
- To control the fluctuation of water level in the river during different seasons
- It raises the water level on upstream side.
- Other uses of this is to regulates the supply of water into canals.
- It controls the entry of silt into canals.
- It provides some poundage creating small pond.
- It helps in controlling the vagaries of river

SITE CHOICE OF A DIVERSION HEADWORK MAY BE:

1. Rocky Stage: River steep slope with high velocity
2. Sub mountainous or boulder stage: boulder or gravel
3. Alluvial plan: Bed slope small with gentle velocity

A headwork site selection should satisfy the following rules:

- The river should have high, well-defined, erodible and non-submersible banks so that the cost of river training work is minimum .
- The site should be such that the headwork can be aligned at right angles to the direction of flow in the river.
- The river section at the site should be narrow and well-defined.
- The canals taking off from the diversion head works should be quite economical and should have a large commanded area.
- There should be suitable arrangement for the diversion of river during construction.
- The river banks should be well defined.
- The valuable land should not be submerged when the weir or barrage is constructed.
- The elevation of the site should be much higher than the area to be irrigated.
- The site should be easily accessible by roads or railways.
- The materials of construction should be available in vicinity of the site.
- The site should not be far away from the command area of the project, to avoid transmission loss.

Q.NO (04) A

ANSWER:

CANAL HEAD REGULATOR

Any structure constructed to regulates the discharge, full supply level or velocity in a canal is known as a. regulator work. This is necessary for the efficient working and. safety of an irrigation channel.

Structure at the head of canal taking off from a reservoir may consist of number of spans separated by piers and operated by gates. Regulators are normally aligned at 90° to the weir. Up to 10" are considered preferable for smooth entry into canal.

The functions of canal head regulator are:

- To admit water into the off taking canal.
- To regulate the supplies into the canal.
- To indicate the discharge passed into the canal from design discharge formula and observed head of water on the crest.
- To control the silt entry into the canal. During heavy floods, it should be closed otherwise high silt quantity will leave to the canal

Q.NO (04) B

ANSWER:

SILT EXCLUDERS

Silt excluders are those works which are constructed on the bed of the river, upstream of the head regulator. The clearer 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 in enters the canal.

A silt excluder consists of a number of rectangular tunnels running parallel to the head regulator and terminating near the under-sluiced weir. The tunnel nearest to the crest of the head regulator has to be at least of the same length as the head regulator. Other tunnels may be shorter in length.

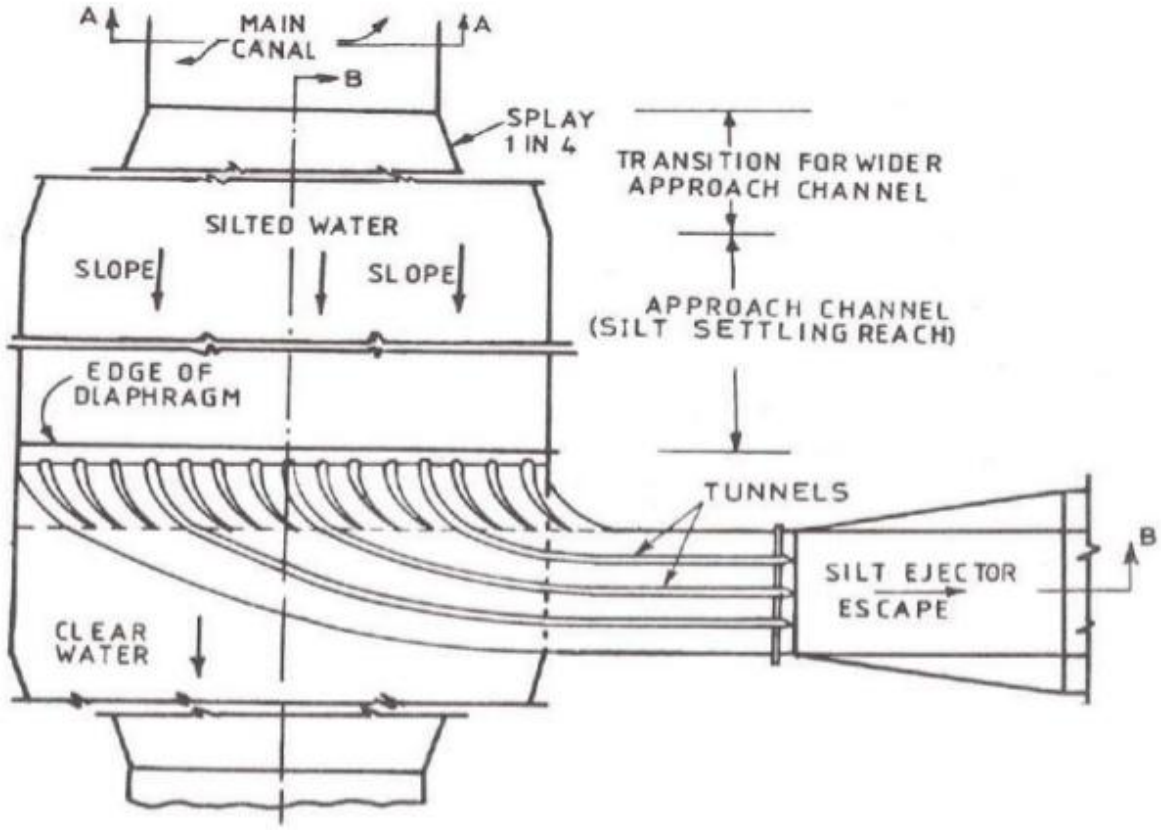


Fig: Plan of Silt Ejector

The following points should be kept in mind while designing a silt excluder:

i) The tunnel discharge through the under sluice is recommended to be 20 per cent of the canal discharge.
ii) The silt excluder should cover only two bays of the under sluice as this was found to be more efficient in the model studies of Kalabagh barrage than a silt excluder covering four bays.

iii) The approach channel need not be lined.

iv) The divide wall should be 1.2 to 1.4 times the head regulator length.

v) The top of the silt excluder slab should be flushed with the head regulator crest, i.e. the clear height of the tunnels would be 1/3 the depth of the water minus the slab thickness.

Principles of Silt Control

- Before we describe the mechanism and functioning of these silt control devices, we shall explain the basic principle on which the silt is removed from the water.
- The fundamental principal the behind silt control is: that most of the silt tries to settle down in water, thus, confining itself mostly in the bottom layers of water.
- We also know that the silt is kept in suspension by the force of the vertical eddies generated by the friction of the flowing water against the bed.

Q.NO (04) C

ANSWER:

UNDER SLUICES

The under-Sluices are the openings which are fully controlled by gates, provided in weir wall with their crest at a low level. They are located on the same side as the off-taking canal. Under sluices are also called scouring sluices because they help in removing the silt near the head regulators.

Functions of Under-Sluices

i) Preserve a clear and defined river channel approaching the regulator.
ii) Control the silt entry into the canal.
iii) Pass the low floods without dropping the shutter of the main weir.
iv) Provide greater water-way for floods, thus lowering the flood level.
v) They scour the silt deposited on the river bed above the approach channel.
vi) To scour silt deposited in front of canal regulator and control silt entry in the canal.
vii) To facilitate working of weir crest shutters or gates. The flood can easily pass.
viii) To lower the highest flood level

Q.NO (04) D

ANSWER:

BALANCING DEPTH

"Balancing canal depth comes when the canal is in partially embankment and partially in cutting. It is the depth of the canal (H) which gives equal amount of filling (i.e earth required for formation of Banks) and cutting (I .e earth from digging). "

If for a channel section the depth of cutting is such that the quantity of excavation or cutting is equal to the earth filling required for making the banks, then depth of cutting is known as balancing depth or most economical depth of cutting.

For a given cross-section of a canal, it has only one balancing depth. For this depth the canal sectional will be economical.

B= Bed width.

b1,b2= width of embankment of left and right side respectively.

d= excavation depth. h= embankment height.

H=height of embankment from the bed of the canal.

X- Sectional area in cutting =Bd+sd2

X- Sectional area in embankment = (b1+b2)h+2s1 h2

FOR BALANCING DEPTH

Area in cutting= Area in embankment.

or, Bd+sd2 = (b1+b2)h+2s1 h2

or, Bd+sd^2=(b1+b2)(H-d)+2s1(H-d)^2.

From this equation'd' can be calculated.

THE END