UNIT-2

CANALS

A Canal is an artificial channel Constructed on the ground or below the ground level to carry water for various purposes. (such as irrigation, power, navigation etc.) either from a river (or) from a Tank or from reservoir.

⊛ classification based on the nature of source of supply: —

1. Permenent Canal
2. Inundation Canal

A Canal is said to be permenant when it is fed by permenent source of supply. The Canal is a well made up of regular graded channel. A permenent Canal is also known as perennial Canal.

Inundation Canal usually draw their supplies from rivers whenever there is a high stage in the river. They are not provided with any headworks for diversion of river water to the canal.

⊛ classification based on financial output: —

① productive Canal ② protective Canal.

productive Canals are those which yeild a net revenue to the nation after full development of irrigation in the Area. protective Canal is a sort of relief work Constructed with the idea of protecting a particular area from the famine

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* Classification based on the function of the Canal.

(1) Irrigation Canal (2) Carrier Canal (3) Feeder

(4) Navigation Canal (5) power Canal

1. An irrigation canal carries water to the agricultural fields

2. A carrier canal besides doing irrigation. Carries water for another canal.

3. A feeder canal is constructed with the idea of feeding two or more canals. Ex. Rajastan feeder Canal and Srihind feeder.

* Classification based on boundary Surface of the Canal.

Based on the Type of boundary Surface, Canals may be of the following Types

1. Alluvial Canals. (2) Non Alluvial Canals (3) Rigid-boundary Canals

(1) An Alluvial Canal is the one in which is excavated in alluvial soils such as silt.

2. A non Alluvial Canal is the one in which is excavated in non-alluvial soils, such as loam, clay, hard soil (murram) rock etc.

3. Rigid boundary Canals are those which have rigid sides and rigid base, Such as lined canals

* Classification based on the discharge and its relative importance in a given network of canal

Main Canal :— Generally Carries water from the river or reservoir. Such a Canal carries heavy Supplies and is not used for direct irrigation except in exceptional circumstances.

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(2)

2. Branch Canals are the branches of the main Canal in either direction taking off at regular intervels. branch canals also donot carryout any direct irrigation.

3. Major Distributaries :— usually Called Rajbha, Take off from a branch Canal. They may also sometime Take off from the main Canal. but their discharge is generally lesser then the branch Canal.

4. Minor Distributaries :— Takes off from branch Canals or from the distributeries Their discharge is usually less then the 1/4 cumecs.

5 Water Course :- a small channel which ultimately feeds the water to irrigation fields.

⊛ Classification based on Canal Alignment :—

According to the alignment, A Canal may be classified as under

(1) Contour Canal
(2) watershed Canal | Risid
3 Side slope Canal.

⊛ Design of erodible Canals :—

Kennedy selected a number of sites on upper Bari Doab Canal system one of the oldest Punjub for carryout investigation about velocity and depth of the channel.

Kennady's method of channel design :—

Design procedure :—

~~C~~ — Assume a Trail value of D in meters.

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(2) Calculate the velocity V_0 from the Equation

$$V_0 = 0.55 m D^{0.64}$$

(3) Get area of section A from the Continuity Equation

$$A = \frac{Q}{V_0}$$

(4) Knowing D and A. Calculate bed width B from Geometry of Canal section

The side slope of the Canal in alluvial soil is assumed to be ½ : 1 where the canal has run for some time

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

From which B can be Calculated

(5) Calculate the perimetre and hydraulic mean Depth from the following relations

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

$$R = \frac{A}{P} = \frac{BD + D^2/2}{B + D\sqrt{5}}$$

(6) Calculate the actual mean velocity of flow (V) from the Kutter's equation. If this value of velocity (V) is same as V_0 found in step (2), the assumed depth is correct. If not, repeat the Calculation with a changed value of D till the two velocities are same.

Case 2: – Given Q, N, m and B/D ratio from wood's Table.

(1) Calculate A in Terms of D

$$\frac{B}{D} = x \quad \text{or} \quad B = Dx$$

$$A = BD + D^2/2 = xD^2 + D^2/2 = D^2(x + 0.5)$$

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(2) The value of velocity V_0 is known in Terms of

D by Kennedy Equation

$$V_0 = 0.55\, m D^{0.64}$$

substitute the value of V_0 and A in Continuity equation and solve for D.

Thus $Q = A \times V_0 = D^2 (x + 0.5) \times 0.55\, m D^{0.64}$

$$Q = 0.55\, m (x + 0.5) D^{2.64}$$

$$D = \left[\frac{Q}{0.55\, m (x + 0.5)} \right]^{1/2.64}$$

In the above relation Q, m and x are known

Hence D is determined

(3) knowing D, Calculate B and R from following relation

$$B = xD$$

$$R = \frac{BD + \frac{D^2}{2}}{B + D\sqrt{5}}$$

(4) Calculate the velocity V_0 from Kennedy's equation

5 $$V_0 = 0.55\, m D^{0.64}$$

(5) Knowing V_0 and R determine slope S from Kutter's flow equation. The equation can be solved by Trail and Error.

Problem: 1. Design an irrigation Canal to Carry a discharge of 14 cumecs. Assume $N = 0.0225$, $m = 1$, and $B/D = 5.7$.

Sol $\frac{B}{D} = 5.7$

$$A = BD + \frac{D^2}{2} = D^2 \left[\frac{B}{D} + 0.5 \right] =$$

$$= D^2 (5.7 + 0.5) = 6.2\, D^2$$

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② $V_0 = 0.55 m D^{0.64}$

$= 0.55 \times 1 \times D^{0.64}$

$Q = A \times V_0 = (6.2 D^2)(0.55 D^{0.64})$

$\therefore D = \left[\frac{Q}{0.55 \times 6.2}\right]^{\frac{1}{2.64}}$

$= \left[\frac{14}{0.55 \times 6.2}\right]^{\frac{1}{2.64}} = 1.707 \simeq 1.71 m$

③ $B = 5.7 D = 5.7 \times 1.71 = 9.73 m$

$R = \frac{BD + \frac{D^2}{2}}{B + D\sqrt{5}} = \frac{9.73 \times 1.71 + \frac{1}{2}(1.71)^2}{9.73 + 1.71\sqrt{5}}$

$= 1.37 m.$

④ $V_0 = 0.55 m D^{0.64} = 0.55 \times 1 \times (1.71)^{0.64} = 0.775 m/s$

But

$V = C\sqrt{RS}$

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

Regime channel:— Lacey defined regime channel as a stable channel transporting a regime silt charge. A channel will be in regime if it flows in unlimited incoherent alluvium of the same character as that transported and the silt grade and silt charge are all constant.

Silt charge:— It is the minimum transported load consistent with fully active load.

Silt Grade:— This indicates the gradation between the small and big particles. It should not be taken to mean the average mean diameter of a particles.

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Kennedy's problem :—

① Design an irrigation channel on Kennedy's theory, to carry a discharge of 45 Cumecs. Take N = 0.0225 and m = 1.05. The channel has a bed slope of 1 in 5000.

Sol step 1.
Let us assume a Trail Depth D = 2m.

step ②
$V_0 = 0.55 m D^{0.64}$
$= 0.55 \times 1.05 \times 2^{0.64}$
$= 0.9$ m/sec.

step ③
$A = Q/V_0 = \frac{45}{0.9} = 50 m^2$

step ④ For a Trepizoidal section having ½ : 1 sides bp
$A = BD + 0.5 D^2$
$50 = B(2) + 0.5(2)^2$ from which B = 24m

step ⑤
perimeter $P = B + D\sqrt{5}$
$= 24 + 2\sqrt{5}$
$= 28.47$ m

$R = A/P = 50/28.47 = 1.756$ m.

step ⑥. Compute velocity of flow from Kutter Equati.

$V = C\sqrt{R.S}$ $S = 1/5000$

$$C = \frac{23 + \frac{1}{0.0225} + \frac{0.00155}{1} \times 5000}{1 + \left[23 + \frac{0.00155}{1} \times 5000\right] \frac{0.0225}{\sqrt{1.756}}}$$

$= 49.4$

$V = 49.4 \sqrt{\frac{1.756 \times 1}{5000}} = 0.926$ m/sec

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Step ⑦

Thus $V_0 < V$ Inorder to increase V_0 increase the Values of D. Let D = 2.2m in the next Trail

$V_0 = 0.55 \times 1.05 (2.2)^{0.64} = 0.957 m/sec.$

$A = \frac{45}{0.957} = 47.04 m^2$

$47.04 = B(2.2) + 0.5 (2.2)^2$

$B = 20.28 m.$

$P = 20.28 + 2.2\sqrt{5} = 25.2 m$

$R = 47.04 / 25.2 = 1.867 m$

$$C = \frac{23 + \frac{1}{0.0225} + \frac{0.00155}{1} \times 5000}{1 + \left[23 + \frac{0.00155}{1} \times 5000\right] \frac{0.0225}{\sqrt{1.867}}} = 49.918$$

$V = 49.918 \sqrt{\frac{1.867 \times 1}{5000}}$

$= 0.965 m/se.$

Ratio b/w two velocities. = 0.965 / 0.957

= 1.008 ≃ 1

Hence no further Trail is necessary

Thus D = 2.2m B = 20.28 ≃ 20.3

② Design an irrigation Canal to Carry a Discharge of 14 cumecs Assume N = 0.0225, m = 1 and B/D = 5.7.

① = $\frac{B}{D} = 5.7.$ $A = BD + 0.5D^2$

$A = BD + \frac{D^2}{2} = D^2 \left(\frac{B}{D} + 0.5\right)$

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②

$A = D^2(5.7 + 0.5) = 6.2D^2$

② $V_0 = 0.55 m D^{0.64} = 0.55 \times 1 \times D^{0.64}$

$Q = A \times V_0$

$= 6.2 D^2 \times 0.55 D^{0.64}$

$D = \left[\frac{Q}{0.55 \times 6.2}\right]^{\frac{1}{2.64}} = \left[\frac{14}{0.55 \times 6.2}\right]^{\frac{1}{2.64}}$

$= 1.707 \simeq 1.71\,m$

③ $B = 5.7D$

$= 5.7 \times 1.71 = 9.73\,m$

$R = \frac{BD + \frac{D^2}{2}}{B + D\sqrt{5}} = \frac{(9.73 \times 1.71) + \frac{1}{2}(1.71)^2}{9.73 + 1.71\sqrt{5}}$

$= 1.37\,m$

④ $V_0 = 0.55 m D^{0.64}$

$= 0.55 \times 1 \times (1.71)^{0.64} = 0.775\,m/sec$

⑤ But $V = \frac{23 + \frac{1}{N} + \frac{0.00155}{S}}{1 + \left[23 + \frac{0.00155}{S}\right]\frac{N}{\sqrt{R}}} \sqrt{RS}$

Keeping $V = V_0$ we get,

$0.775 = \frac{23 + \frac{1}{0.0225} + \frac{0.00155}{S}}{1 + \left(23 + \frac{0.00155}{S}\right)\frac{0.0225}{\sqrt{1.37}}} \sqrt{1.37 \times S}$

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$$0.775 = \frac{23 + 44.5 + \frac{0.00155}{s}}{1+0.44+ \frac{2.98}{s} \times 10^{-5}} \times 1.17 \times s^{1/2}$$

which reduces to.

$$\frac{0.775}{1.17}\left[1.44 + \frac{2.98}{s} \times 10^{-5}\right] = \left(67.5 + \frac{1.55}{s} \times 10^{-3}\right) s^{1/2}$$

$$67.5\, s^{3/2} + 1.55 \times 10^{-3}\, s^{1/2} - 0.954 s = 1.98 \times 10^{-5}$$

$$s^{3/2} + 2.29 \times 10^{-5}\, s^{1/2} - 1.41 \times 10^{-2} s = 2.93 \times 10^{-7}$$

$$\boxed{s = \frac{1}{5100}}$$

Lacy's problem's

① A channel section has to be designed for the following data

Discharge $Q = 30$ cumes

Silt factor $f = 1.0$

Side slopes $= 1/2 : 1$

find also longitudinal slope.

Sol: 1. The values of f is given as. $f = 1.00$

2. velocity $V = \left[\frac{30 \times 1}{140}\right]^{1/6} = \frac{Qf^2}{140}$

$= 0.773$ m/sec.

3. Area $= A = \frac{30}{0.773} = \frac{Q}{V} = 38.8$ sq.m

4. $P = 4.75\sqrt{Q} = 4.75\sqrt{30}$

$= 26$m

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$$D = \frac{P - \sqrt{P^2 - 6.944A}}{3.472} = \frac{26 - \sqrt{676 - 6.944 \times 38.8}}{3.472}$$ (6)

$= 1.67m$

$$B = P - 2.236D$$

$= 26 - 2.236 \times 1.67 = 22.26\ m.$

(6) Hydralic mean Radius.

$$R = \frac{5}{2}\frac{v^2}{f} = 5/2 \times \frac{1}{1}(0.773)^2 = 1.49\ m$$

$$R = \frac{BD + \frac{D^2}{2}}{B + D\sqrt{5}} = \frac{1.67(22.26) + 1.67^2/2}{22.26 + 1.67\sqrt{5}}$$

$= 1.49m.$

Hence checked.

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

$$= \frac{1}{3340\,(1.764)}$$

$$= \frac{1}{5880}.$$

Hence, the channel has a Bed width $B = 22.26$

$D = 1.67$

longitudinal slope $S = 1/5880.$

(2) Design a channel by Lacey's theory for 40 cumes capacity. The side slope may be assumed to be 1:1. The average size of the bed material may be taken as 0.8 mm.

Ans. silt factor, $f = 1.76\sqrt{m_d} = 1.76\sqrt{0.8} = 1.57$

$$V = \left[\frac{Qf^2}{140}\right]^{1/6} = \left[\frac{40(1.57)^2}{140}\right]^{1/6} = 0.943\ m/sec$$

$$A = Q/V = 40/0.943 = 42.41\ m^2$$

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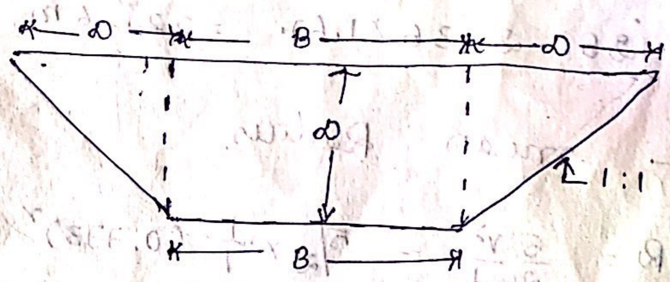
$\therefore P = 4.75\sqrt{Q}$

$= 4.75\sqrt{40} = 30.04 m.$

For a Trapezoidal Canal with 1:1 side slopes, we have

$$A = D \times \left[\frac{B + (B+2D)}{2}\right] = D(B+D)$$



$$P = B + 2(D\sqrt{2}) = B + 2.828D.$$

Hence $D(B+D) = 42.41 \longrightarrow (1)$

$B + 2.828D = 30.04 \longrightarrow (2)$

Substituting the values of B from (ii) into (i)

we get

$$D^2 + D(30.04 - 2.828D) = 42.41$$

$$1.828D^2 - 30.04D + 42.41 = 0$$

from which $D = 1.56$

Hence from (i)

$$B = 30.04 - 2.828 \times 1.56 = 25.63 m$$

$$\approx 25.7 m$$

$$R = \frac{5}{2}\frac{v^2}{f} = \frac{5}{2}\left(\frac{(0.943)^2}{1.57}\right) = 1.416 m$$

$$A = 1.56(25.63 + 1.56) = 42.416 m^2$$

$$P = 25.63 + 2.828 \times 1.56 = 30.04$$

$$R = \frac{42.416}{30.04} = 1.412 m$$ Hence OK

$$S = \frac{f^{5/3}}{3340\, Q^{1/6}} = \frac{(1.57)^{5/3}}{(3340)(40)^{1/6}} = \frac{1}{2912}$$

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Design of Irrigation channels : SILT Theories :—

On account of erosion in the drainage basin, rivers receive a large amount of sediment along with water The sediment consists of soil particles of various sizes ranging from fine silt to coarse sand.

The canal takes off form a river, a portion of this silt is also received by the canal which draw the water directly from the rivers. This silt is carried either in suspension or along the bed of the channel. The silt load carried by the canal create a problem in channel design. The velocity to be allowed in a channel design should be such that the silt flowing in the channel is not dropped on the bed. The bed and sides of the channel may be scoured if the velocity of flow is too high. If the silting may takes place if the velocity of flow is too low. If the bed and sides of the channel are scoured the cross-section increases and its full supply depth decreases which will result in reducing its command area. On the other hand if silting takes place in the channel, its capacity reduces and it will irrigate less area. A velocity which will just keep the silt in suspension without scouring the channel bed is known as non-silting and non-scouring velocity.

2] Kennedy's Theory

R.G. Kennedy is an executive Engineer of Punjab P.W.D who carried out a lot of research work for obtaining a stable non-silting, non scouring channel. He made observation on the channels of upper Bari Doab channel canal system. On these canal system Kennedy selected ... of sites on various channels which was not

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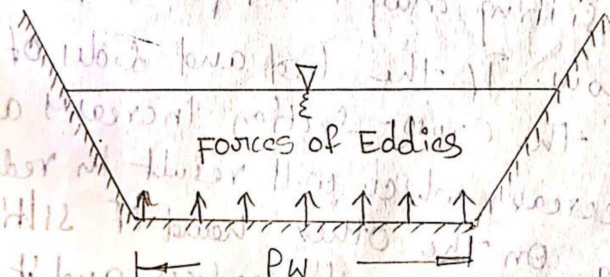
Silt cleared of for a longer period it is recognised that the canal has attained stable stage and velocity of flow has also attained critical velocity. Later he developed a theory which is known as Kennedy's theory. This is also called as transportation theory.

According to Kennedy's theory the silt carried by flowing water in channel is kept in suspension solely by the vertical component of eddies which are generated over the full width of the channel and rise up gently to the surface. The reason for the production of eddies is the roughness of the bed. Some times eddies may also be generated from the sides but these are most of its part horizontal and hence do not have any silt supporting power.



Kennedy's Theory

Kennedy also stated critical velocity (V_0) as the mean velocity which just keep the channel free from silting (or) scouring. Later by plotting the observation of mean velocity and depth of flow Kennedy gave a relation between critical velocity and depth of flowing water. The relation is

$$V_0 = 0.55\, D^{0.64}$$

where V_0 = critical velocity in m/sec

D = Depth of flow in m. In general

$V = CD^n$ where "n" is any index number

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The above equation has been derived on the basis of observation on one canal only. Hence, it is applicable to channels which are having the silt of the same grade as that upper Bari Doab canal system.

Latter Kennedy realised the importance of silt grade on critical velocity and introduced a factor "m" known as critical velocity ratio (C.V.R) in his equation. Above equation is written as

$$V = 0.55\, m\, D^{0.64}$$

where $m = C.V.R = \frac{V}{V_0}$

Value of "m" may be taken 1.1 to 1.2 for coarse sand, and for finer material its value may be kept between 0.8 to 0.9. The value of "m" for upper Bari Doab canal system was taken to be unity (m = 1). The value of m in equation for different types of silt are given in table.

S.No	Region	Value of m
1.	upper bari doab canal system	0.64
2.	Lower Chenab canal system	0.50
3.	Godavari delta region	0.55
4.	Krishna delta region	0.52

Kutter's equation is used by the Kennedy for finding the mean velocity of flow in the channel.

$$V = \frac{\frac{1}{N} + 23 + \frac{0.00155}{S}}{1 + \left[23 + \frac{0.00155}{S}\right]\frac{N}{\sqrt{R}}}$$

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where

V = Mean velocity of the channel in m/sec

R = Hydraulic mean depth in m

S = Bed slope

N = co-efficient of rugosity depend upon the channel condition and discharge

The value of N may be taken from 0.02 to 0.03 for different channel condition.

Drawbacks in Kennedy's Theory

1. Definition of silt grade and silt charge are not given
2. Kennedy did not given any slope equation
3. The signification of B/D ratio is not considered in his theory
4. The design of is for only an average regime channel
5. Design based on this theory involves trial and error which is quite difficult

LACEY'S THEORY

Gerald Lacey retired chief Engineer from Irrigation Department in uttar pradesh has carried out a detailed study to evolve more scientific method of designing irrigation channel on alluvial soils. He presented his study in 1939 which is popularly known as Lacey's Theory. According to Lacey's Theory a channel to achieve regime condition following three conditions have to be fulfilled

i) Channel should flow uniformly in "Incoherent unlimited" alluvium of same character as that transported by the water. [Incoherent alluvium means loose granular material which can be scoured easily and it can be deposited

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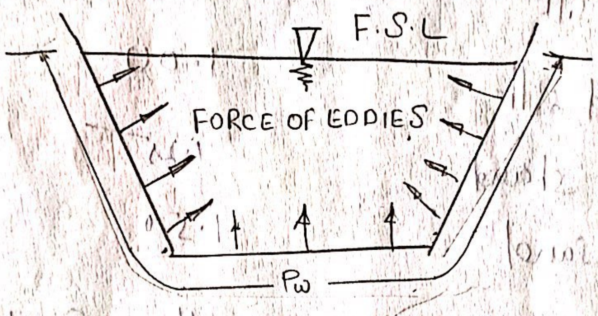
ii) Silt grade and silt charge should be Constant (9)

iii) Discharge should be constant



LACEY'S THEORY

Lacey Also states that the silt kept in suspension by forces of Vertical Components of eddies. These eddies are generated at all point on the wetted perimeter. The force of eddies may be taken normal to the sides.

These eddies are responsible for keeping the silt in suspension.

Lacey takes hydraulic mean radius (R) as variable in the problems rather than depth (D) assumed by "Kennedy"

Lacey recognised the Important of silt grade in the problem and introduced a factor "f" known as silt factor. The value of "f" may be determined by the following relation

$$f = 1.76\sqrt{m_r}$$

where m_r = Mean particle size in mm

= d_{50} in mm

The values of f for various grade size of soils particles are given in Table

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Table

Type of soil	Value of "f"
fine silt	0.50 to 0.70
Medium silt	0.85
Standard silt	1.00
medium sand	1.25
course sand	1.50

Lacey further states that standard silt is sandy silt in a regime channel with hydraulic mean radius R

Designs very Imp

(1). Design of channel by Kennedy's theory

The following steps are to be adopted while designing a channel by Kennedy's theory. If discharge, bed slope, velocity ratio and co-efficient of rugosity are known

Let Bed slope = S

Discharge = Q m^3/sec

Critical velocity ratio = m

Procedure:

(i) Assume a trial depth of flow say D meters

(ii) Calculate critical velocity by using Kennedy's formula

$$V_0 = 0.55\, m\, D^{0.64}$$

(iii) Find the area of cross section (A) by using the Vecuh

$$A = \frac{Q}{V_0}$$

(iv) Assuming side slope of canal as $\frac{1}{2}:1$ calculate width of the canal (B) with the relation

$$A = (B + nD)\, D$$

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v] Calculate the wetted perimeter (P) from relation (10)

$P = B + 2D\sqrt{n^2+1}$ {where 'n' is side slope}

vi] Find the hydraulic mean depth {R} by using the formula

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

vii] Find Kutter's Constant "C" from the equation

$$C = \frac{\frac{1}{N} + \left[23 + \frac{0.00155}{S}\right]}{1 + \left[23 + \frac{0.00155}{S}\right]\frac{N}{\sqrt{R}}}$$

where N is co-efficient of rugosity

viii] Calculate the actual Velocity by using Chezy's formula

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

ix] If the Velocity V is equal to the Critical Velocity V_0 calculated by using Kennedy's equation the assumed depth is satisfactory otherwise another trial depth is assumed and the calculations are repeated until the value of 'V' is equal to the value of V_0

Design

(2) Design of Channel by Lacey's Theory

If the discharge (Q) and the silt factor or mean diameter of silt particle (D_m) are known the irrigation channel should be designed by Lacey's Theory as follows,

(i) Calculate the silt factor (f) from

$$f = 1.76\sqrt{D_m}$$

(or) adopt its value from the soil type

(ii) for a given discharge and silt factor, calculate the Velocity

$$V = \left(\frac{Qf}{140}\right)^{1/6}$$

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(iii) Find the area from the relation

$$A = \frac{Q}{V}$$

(iv) Calculate wetted perimeter

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

(v) Calculate hydraulic mean depth

$$R = \frac{5}{2}\left[\frac{V^2}{f}\right]$$

vi) Having calculated value of A and P by Assuming side slopes n:1 calculate the bed width B and depth D

$$A = [B + nD]\, D$$

$$P = B + 2D\sqrt{n^2+1}$$

(vii) Find the hydraulic mean depth {R}

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

(viii) Calculate the bed slope (S) from the relation

$$S = \left[\frac{f^{5/3}}{3340\, Q^{1/6}}\right]$$

(A) Kennedy's Problem

Design an Irrigation canal for the following data by using Kennedy's Theory

full Supply discharge = 13.5 m³/sec

Bed Slope = 1 in 5000

Coefficient of rugosity = 0.0225

Critical Velocity ratio (m) = 1

Side slope = $\frac{1}{2}$: 1

{Horizontal to Vertical relation 1:1}

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Assume any other data required suitably (11)

Sol/ Assuming full supply data 2.0 m

Velocity can be calculated by using Kennedy's equation

$V_0 = 0.55 m \times D^{0.64}$

$= 0.55 \times (2)$

$= 0.85$ m/sec

from equation

$Q = A \times V$

$A = \frac{Q}{V} = \frac{13.5}{0.85} = 15.88 m^2$

$A = \{B + nD\} D = BD + nD^2$

$15.88 = \{(B \times 2) + \frac{1}{2} (2)^2\}$

$B = 6.94$ m

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

$= 6.94 + 2\sqrt{5} = 11.41$

$R = \frac{A}{P_w} = \frac{15.88}{11.41} = 1.39$

Chezy's constant can be calculated from Kutter's formula

$$C = \frac{\frac{1}{N} + \left\{23 + \frac{0.00155}{S}\right\}}{\left\{23 + \frac{0.00155}{S}\right\} \times \frac{N}{\sqrt{R}}}$$

$$= \frac{\frac{1}{0.025} + \left\{23 + \frac{0.00155}{0.0002}\right\}}{\left\{23 + \frac{0.00155}{0.0002}\right\} \times \frac{0.025}{\sqrt{1.39}}}$$

$C = 48.52$

Now using chezy's formula

Velocity $V = C\sqrt{RS}$

$V = 48.52\sqrt{1.39 \times \frac{1}{5000}}$

$= 0.808$ m/sec

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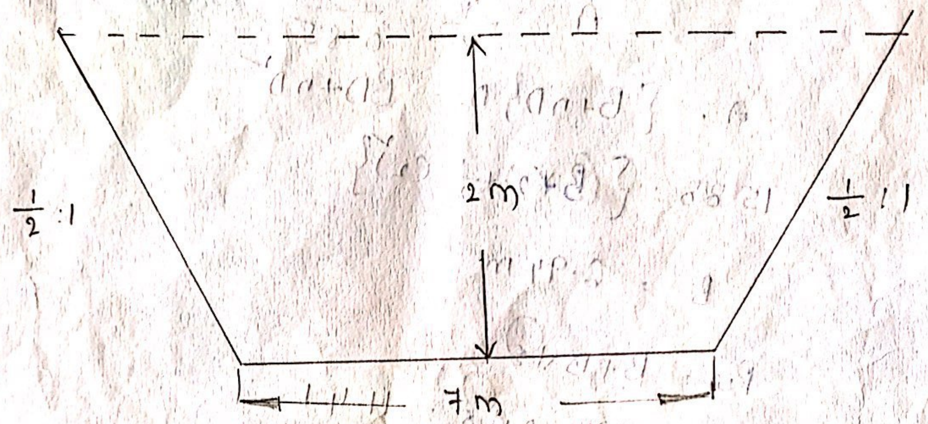
Thus the Velocity calculated is very closed to the Velocity obtained by Kennedy's equation. Hence the design is safe and the assumed D is satisfactory.

The dimensions of the Irrigation canal are follows

Bed width of the canal $B = 6.94$ say $7\,m$

Depth of the canal $D = 2\,m$

Bed slope $S = \frac{1}{5000}$



Dimensions of Designed canal

Short Answers

1] SILT FACTOR:

Req. K. It is a physical constant and generally denoted by Letter "f". It is a function of silt grade. It is also dependent on silt charge density and shape of silt particles. Its value depends on the characteristics of bed material present at the site under consideration

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Definition of Lining

In Irrigation channels to control the Seepage Losses and to run the channels in an efficient manner for the use of Irrigation water, it is necessary to give an Impervious layer to the bed and sides of a canal. This Impervious layer is called "Lining"

The following are the advantages of Lining

(i) Canal Lining controls Seepage and hence minimize transmission Losses.
(ii) By giving Lining to canal, Velocity of flow can be Increased
(iii) It is an Important anti water-Logging measure
(iv) Due to Lining, Velocity of flow can be Incre... inturn Increases the command area.
(v) It Increases available head for power generation
(vi) It makes the canal Section Stable.
(vii) It reduces the maintenance cost of canals.
(viii) Lining prevent bank erosion and breaches.
(ix) It control the weed growth in canals.
(x) It ensures economical distribution of water.

3] Control Canal :- In this method the canal is aligned along the falling contour. Hence it is named as contour canal. The flow of water is generally perpendicular to the slope of the ground. Hence, the contour canal cuts across the natural drainage courses

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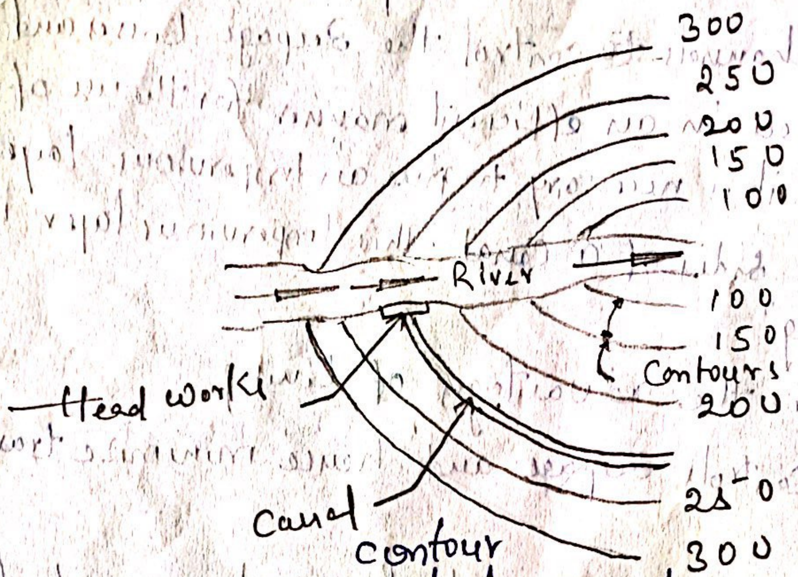

contour ~~Control~~ Canal

Contour canals can irrigate only on one side, as the area on the other side can't irrigate because of higher contour contour lines. In this type the land is very high on one side hence it is not necessary to construct the bank on higher side. Generally higher side is left without bank that is why it is also called as single bank canal.

4) Ridge canal:- This is also known as watershed canal. In this method of alignment the canal will run along the ridge points. Hence it is possible to avoid the cross drainage works which in turn reduces the cost of the canal.

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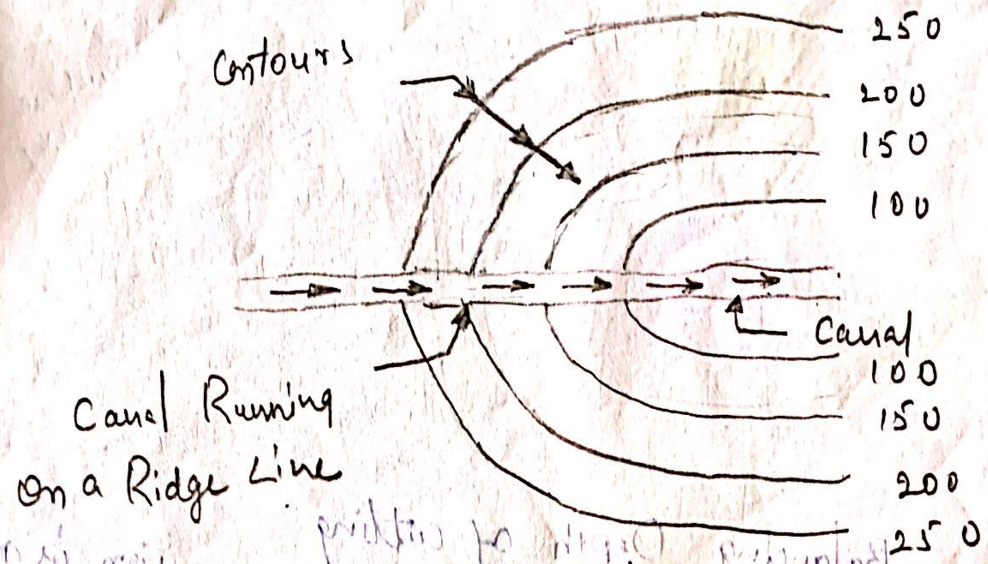

RIDGE CANAL

Since the canal is aligned is aligned at the highest level it is possible to irrigate on both sides of the canal. It requires construction of banks on both sides hence it may be termed as double bank canal. It is preferable to contour canal which have irrigation only on one side.

Balancing Depth of cutting

In irrigation canal water flows under the force of gravity. To achieve this condition the F.S.L is generally kept above the ground surface level. Naturally to hold the water in the channel it is partly excavated below the ground surface and partly built above the ground level

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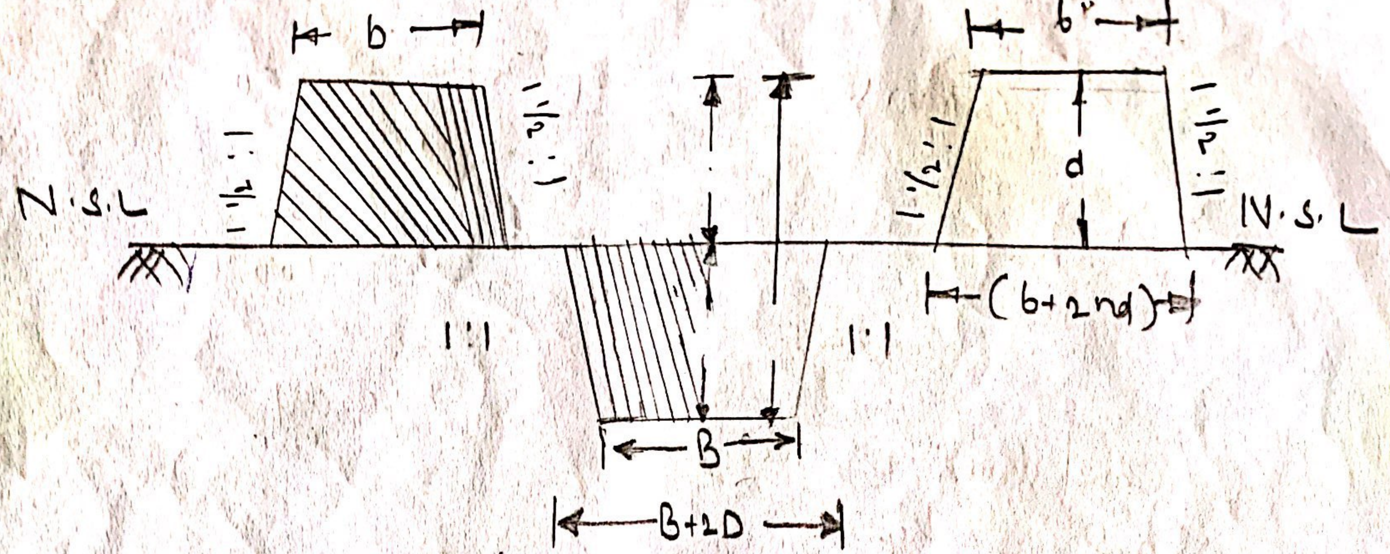

Balancing Depth of cutting

for achieving economy, the depth of excavation is arranged in such a way that the quantity of earth excavated from the canal section is just sufficient to construct the banks. when the depth of cutting is adjusted to achieve above mentioned condition the canal section is said to be "most Economical section" and the depth of excavation is then called "Balancing depth".

Let b = Top width of bank

h = Vertical height of the top of the bund above the bed of the canal

n = Bank slope

B = Bed width of the canal

D = Balancing depth of cutting

m = Cutting slope

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