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Declaration and Statement of authorship

I, bearing Registration Number, 103117086, agree and acknowledge that:

1. The assessment was answered by me as per the instructions applicable to each assessment, and that I have not resorted to any unfair means to deliberately improve my performance.
2. I have neither impersonated anyone, nor have I been impersonated by any person for the purpose of assessments.

Signature of the students: Garishma

Full name: Garishma Bhandari

Roll number: 103117086

Sub code: CEPC 29 Irrigation and Hydraulic Engineering

Mobile number: +977 9841605599

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1.

a) Kor depth: It is the depth of water applied for the kor watering.

Kor period: The portion of the base period in which first watering is needed is called kor period.

Field capacity: It is the maximum amount of water left in the soil after losses of water to the force of gravity have ceased and before surface evaporation begins.

b) Solution.

Given:-
Field capacity = 30%
Permanent wilting point = 15%
Density of soil = 1.5g/cc
effective depth of root zone = 75cm
daily consumptive use of water for given crop = 10mm.
Base period = ?

Now,

Water holding capacity above the wilting point is

$$= \text{Field capacity} - \text{Permanent wilting point}$$
$$= 30 - 15$$
$$= 15\%$$

Assuming for healthy growth moisture content must not fall below 25% of water holding capacity,

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i.e. optimum moisture, $m_o = 30 - 0.75 \times 15$
$= 18.75$

Now,

depth of water required is given as,

$$d_w = \frac{\rho_d}{\rho_w} \cdot d_e [F_c - m_o]$$

or, $= 1.5 \times 75 \left[\frac{30}{100} - \frac{18.75}{100}\right]$

$\therefore d_w = 12.656 \text{ cm} \sim 126.56 \text{mm}$

Now,

watering level $= \frac{126.56}{10} = 12.656 \sim 13$

$\therefore$ For about 13 days we must supply water to soil for ensuring efficient irrigation of given crop.

c) Evaporation is the process by which water is changed from the liquid or solid state into the gaseous state through the transfer of heat energy whereas consumptive use of water is the quantity of water used by the vegetation growth of a given area. Mathematically, consumptive use of water is the sum of evaporation and transpiration.

The factors which affects the consumptive use of water requirement are listed below:-

i) Humidity of the area (which evaporation depends on)
ii) Mean monthly temperature
iii) Monthly precipitation in area.

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iv) Wind velocity in locality
v) Growing season of crops and cropping pattern.

2.

a. The main causes of failure of weirs on permeable foundation occur either due to
i) sub-surface flow and ii) surface flow.

The failure due to sub-surface flow is further divided into:-
1) Failure due to piping: Here, the continuous percolation of water from upstream side to downstream side causes scouring effect and removes the soil at the point of emergence. A depression is formed which extends backwards towards the upstream. A hollow pipe like formation thus develops and weir fail by subsiding. This phenomenon is called undermining.

2) Failure by uplift pressure: When the weight of the floor isn't adequate enough to counterbalance the uplift pressure the weir falls by rupture of floor.

The failure due to surface flow is further divided into:-
1) Failure by suction pressure: Here, in the glacis type of weir, hydraulic jump is formed on the d/s glacis. Because of water surface profile in the hydraulic jump which is lower than subsoil H.G.L, uplift pressure is created known as suction pressure. When our thickness of

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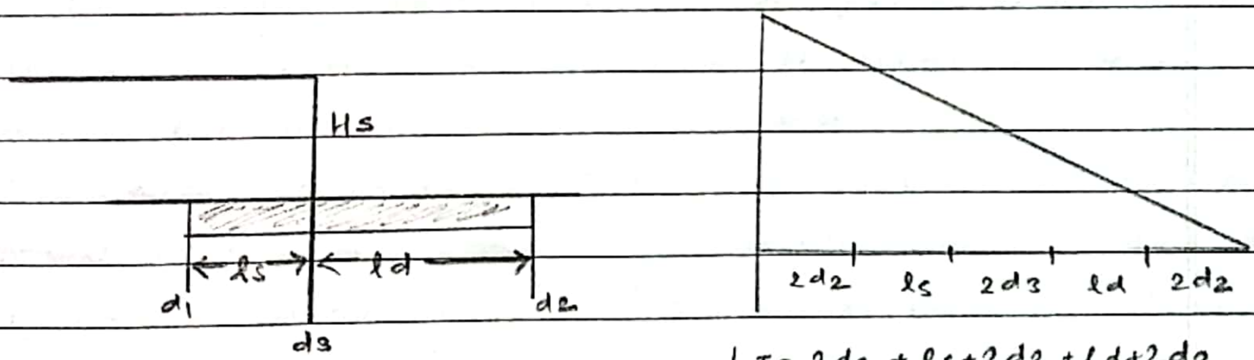
floor is inadequate, the floor fails by rupture.

2) Failure by scour : Scouring occurs mostly during floods when our scouring depth is high and if no suitable measures are adopted, scouring causes damage to the structure causing failure..

b. Bligh's creep theory was given by W.G. Bligh in 1910. The main assumption made in this theory is that the length of the path traversed by the percolating water is proportional to the head loss.

For the safe design of apron in an irrigation work Bligh assumed that the hydraulic gradient is constant throughout the impervious length of the apron and the percolating water creeps along the base profile of the apron with the subsoil, losing head enroute, proportional to the length of its travel.



$L_T = 2d_2 + l_s + 2d_3 + l_d + 2d_2$

Using the Bligh's creep theory, the known seepage head and creep coefficient, the required creep length on seepage path is,

$L_T = CH_s$

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2.c.

Solution,

Total max. head loss = H_L = 2+0.6 = 2.6 m

Length of creep required including creep along cut-off.

$= L = C \cdot H_L = 12 \times 2.6 = 31.2\,m$

The length of downstream floor is given by,

$$L_2 = 2.21\, C \sqrt{\frac{H_L}{13}}$$

or, $$L_2 = 2.21 \times 12 \times \sqrt{\frac{2.6}{13}}$$

$\therefore L_2 = 11.8\,m \sim 12\,m.$

The bottom width of weir = B = 3.5 m

For provision of cut offs,

Let us first calculate as to what will be the head over the weir when high flood discharge is passing.

Use, $q = 1.7 H^{3/2}$

$$q = \frac{Q}{L} = \frac{300}{40} = 7.5$$

or, $7.5 = 1.7 H^{3/2}$

$\therefore H = 2.68\,m$

The head over the weir crest is 2.68 m.

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∴ upstream High flood level (if we assume bed level as 100m and crest as 102m) $= 102+2.68$
$= 104.68m$

Now,

R = Lacey's regime scoured depth $= 1.35\left(\frac{q^2}{f}\right)^{1/3}$

Let $f=1$.

Then $R = 1.35 \times \left(\frac{7.5^2}{1}\right)^{1/3} = 5.18m$

Depth of u/s sheet pile from below u/s HFL $= 1.5R = 1.5 \times 5.18 = 7.8m$

∴ Level of bottom of u/s sheet pile $= 104.68 - 7.8 = 96.88m$

Provide depth of $(100 - 96.88) = 3.02m$

Now, Total creep length provided except u/s floor
$= 2\times3m + 3.5m + 12m + 2\times3m = 27.5m$

Balance length $= 312 - 27.5 = 3.7m$ (say 5m)

∴ Total creep length $= 27.5 + 5 = 32.2m$

Now, we know,

$L_2 + L_3 = 18C\sqrt{\frac{H_L}{13} \cdot \frac{q}{75}}$ (L_3 is the length of downstream loose talus)

or, $L_2 + L_3 = 18 \times 12\sqrt{\frac{2.6}{13} \cdot \frac{7.5}{75}}$

or, $L_3 = 31.6 - 11.8$

∴ $L_3 = 19.8m \sim 20m$

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Hence, provide d/s loose talus of 20 m in length.

D/s floor thickness

The H.G line is now plotted as shown below. The maximum ordinate of the H.G line above the bottom of the floor for the downstream portion at the junction of weir wall is,

$$= \frac{2.6}{32.3} \times 18 = 1.45m. \ (h)$$

The thickness of D/s floor at this point is then obtained by

$$t = 1.33\left(\frac{h}{G-1}\right)$$

or, $$= 1.33\left(\frac{1.45}{2.4-1}\right)$$

$$\therefore t = 1.4m$$

Thus, provide 1.4m thickness for D/s floor from just near its junction with weir wall.

For thickness,

The thickness required at halfway of D/s floor length,

$$= \frac{1.33h}{1.4}$$

$$= \frac{1.33 \times h}{1.4}$$

where,

$$h = \frac{2.6}{32.3} \times 12 = 0.97m$$

$$= \frac{1.33 \times 0.97}{1.4} = 0.92m \ (\text{say } 1m)$$

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Further, provide a nominal thickness of 0.5m below the u/s floor and 1m below the weir wall.

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a. Regime channel is the channel in which the character of the bed and bank materials are the same as that of the transported materials & silt charge and silt grade are constant.

Kennedy's Theory	Lacey's Theory
1. It states that the silt carried by the flowing water is kept in suspension by the vertical component of eddies which are generated from the bed of the channel	1. It states that the silt carried by the flowing water is kept in suspension by the vertical component of eddies generated from the entire wetted perimeter of the channel.
2. It gives the relation between 'V' and 'D'.	2. It gives relation betn 'V' and 'R'
3. In this theory, Kutter's equation is used for finding the mean velocity.	3. This theory gives an equation for finding the mean velocity.
4. Here, the theory depends upon trial and error method	4. It doesn't involve trial and error.
5. In this theory, a factor known as critical velocity ~~factor~~ ratio 'm' is introduced to make the equation applicable to different channels with different silt grade.	5. In this theory, a factor known as silt factor 'f' is introduced to make the equation applicable to different channels with different silt grades.

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3.c

Kennedy's Theory	Lacey's Theory
1. It states that the silt carried by the flowing water is kept in suspension by the vertical component of eddies which are generated from the bed of the channel	1. It states that the silt carried by the flowing water is kept in suspension by the vertical component of eddies generated from the entire wetted perimeter of the channel.
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5. In this theory, a factor known as critical velocity ~~factor~~ ratio 'm' is introduced to make the equation applicable to different channels with different silt grade.	5. In this theory, a factor known as silt factor 'f' is introduced to make the equation applicable to different channels with different silt grades.

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3.

c. Solution,

Given:-

Discharge = 45 cumecs

$n = 0.0225$

$m = 1$

bed slope = 0.15 m per kilometer $= \frac{0.15m}{1000m} = 0.00015$ (1)

Now, according to question we have to take trial depth 'D' as 1.8m and use Kennedy's theory.

Step 1: Calculate critical velocity,

$$V_0 = 0.564\,D^{0.64}$$

or, $= 0.564 \times (1.8)^{0.64}$

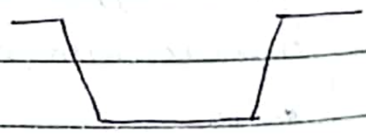
$\therefore V_0 = 0.82158$ m/s.

Step 2: Calculate A,

$$A = \frac{Q}{V_0} = 54.77205\,m^2$$

Assuming sideslope as 1:1.

Step 3: $A = \left(\frac{B+B+D+D}{2}\right) \times D$



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

or, $54.77205 = (B + 1.8)\,1.8$ — (1)

$\therefore B = 28.63$ m.

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Step 4: Wetted perimeter.

$$P = B + 2\sqrt{2}D$$

or, $P = B + 2\sqrt{2} \times 1.8$

or, $P = 28.63 + 5.09116$

$\therefore P = 33.72m$.

Step 5: Using kutter formula, for finding Chezy's constant

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

$R = \frac{A}{P} = \frac{54.774}{33.72} = 1.6244$

or, $$= \frac{\frac{1}{0.0225} + 23 + \frac{0.00155}{0.00015}}{1 + \left[23 + \left(\frac{0.00155}{0.00015}\right)\right]\frac{0.0225}{\sqrt{1.6244}}}$$

or, $$= \frac{77.78}{1.588}$$

$\therefore C = 48.979$

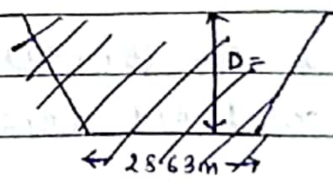
Step 6: Mean velocity,

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

or, $= 48.979 \times \sqrt{1.6244 \times 0.00015}$

$\therefore V = 0.7645 m/s$.

Since, $V < V_0$, silting action may occur.



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a.

Solution,

Given:-

Supply discharge = 10 cum.

Lacey's silt factor (f) = 0.9

side slope = 0.5 : 1.

Using Lacey's silt theory,

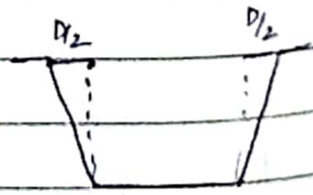
Step 1: Finding the velocity,

$$V = \left(\frac{Qf^2}{140}\right)^{1/6} = \left(\frac{10 \times 0.9^2}{140}\right)^{1/6} = 0.622\ m/s.$$

Step 2: Finding the area,

$$A = \frac{Q}{V} = \frac{10}{0.622} = 16.077\ m^2$$

Step 3: $$A = \left(\frac{B + B + D/2 + D/2}{2}\right) \times D$$



or, $A = (B + 0.5D) \times D$

or, $16.077 = (B + 0.5D) \times D$ — 1

Step 4: Finding wetted perimeter,

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

or, $B + 2 \times 1.118 D = 4.75\sqrt{10}$

or, $B = 15.0208 - 2.236D$ — (11)

Substituting value of 'B' in (1)

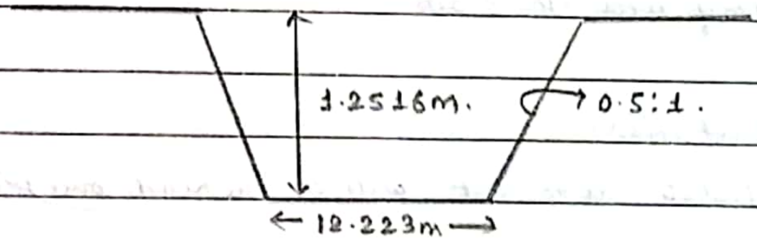
or, $16.077 = [(15.0208 \cancel{+0.5D} - 2.236D) + 0.5D]D$

or, $16.077 = 15.0208D - 1.736D^2$

$\therefore D = 7.401\,m,\ 1.25126\,m.$

Corresponding value of B is, $(-1.527,\ 12.223)$

$\therefore$ The value of $B = 12.223\,m$ and $D = 1.2516\,m$.



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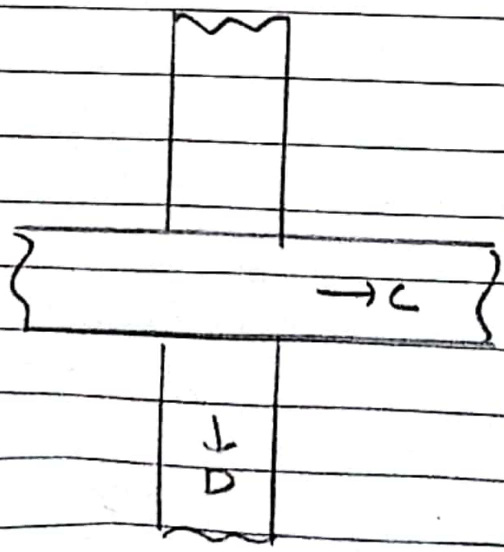
4-6.

A cross drainage work is a hydraulic structure which needs to be constructed at the crossing of a natural stream and an irrigation canal flowing normally at right angles underneath or over the natural stream.

The cross drainage works are classified depending upon the relative bed levels, maximum water levels and relative discharges of canals and drainages. They are

i) Irrigation canal passing over the drainage.

Here, an irrigation canal is taken over the drainage. It involves construction of aqueduct, siphon aqueduct. The main advantage with this type of cross drainage work is that the canal running perennially is above the ground and is open to inspection. Major disadvantage is during the high floods, the foundation can be scoured or the water way of the drain may be chocked with trees.



C – Canal
D → Drainage

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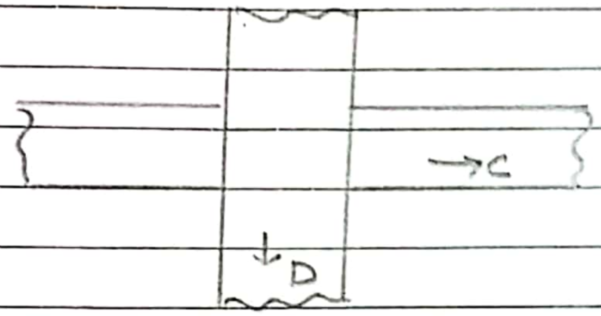
ii) Drainage passing over the irrigation canal.

The main advantage of this type is that cross drainage works are less liable to damage the earthwork of canal. The disadvantage is that the perennial canal is not open to inspection unlike the latter.



iii) Drainage and canal intersection at the same level.

Here, the canal water and drainage water are permitted ~~water are~~ to intermingle. The major disadvantage is that the regulation of such work is difficult and requires additional staff and add an additional expenditure is required to silt clearance.