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IRRIGATION ENGINEERING

[BTAI 2201]

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Sample Calculation:

Design an irrigation canal to carry a discharge of 24 cumecs with permissible mean velocity of 2.88 km/hr. Bed slope of the canal section is 0.02 percent and side slope is 1:1. Assume Chezy's constant (C) as 44. Assume any other data not given in the problem.

Solution:

Given discharge, $Q = 24 \text{ m}^3/\text{sec}$

Mean velocity of flow, $V = 2.88 \text{ km/hr} = 0.80 \text{ m/sec}$

Cross sectional area, $A = Q/V = 24/0.80 = 30 \text{ m}^2$

Let base width of the canal be B and depth be D . Since side slope is 1:1, top width is $(B + 2D)$

Cross sectional area = $(B + D) D$

Hence, $(B + D) D = 30$

Mean velocity by Chezy's formula is



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$$V = C \sqrt{R S}$$

Given, $V = 0.80$ m/sec, $C = 44$ and $S = 0.02$ percent =
0.0002

$$\text{Hence, } 0.80 = 44 \sqrt{R \times 0.0002} \quad R = 1.65$$

$$\text{Wetted perimeter, } P = B + 2 \sqrt{2} D$$

Hydraulic mean radius, $R = \text{Cross sectional area/wetted perimeter} =$

$$\frac{(B + D) D}{B + 2 \sqrt{2} D}$$



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$$\frac{(B + D) D}{B + 2 \sqrt{2} D} = 1.65$$

$$\frac{30}{B + 2 \sqrt{2} D} = 1.65$$

Simplifying $B = 18.18 - 2.83 D$

Now Put value of B in Eq. $(B + D) D = 30$ and solve

$1.83 D^2 - 18.18 D + 30 = 0$ which gives $D = 7.84$ or 2.09

If $D = 7.84$, $B = -4.0$ (impossible)

If $D = 2.09$, $B = 12.27$ (OK)



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Sample Calculation 2:

Design the most economical trapezoidal canal section to carry a discharge of $20 \text{ m}^3/\text{sec}$ with mean velocity of flow of 3.06 km/hr . Side slope of the canal is $1.5:1$. Assume Bazin's constant, $K = 1.30$. Also calculate the allowable bed slope of the canal.



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Sample Calculation 3:

Design a canal section to carry a discharge of 40 m³/sec with mean velocity of flow of 3.42 km/hr. Side slope of the canal is 1:1. The ratio of base width to depth of flow in the section is given as $B/D = 6.5$. Assume value of coefficient of rugosity, $N = 0.0225$.



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Design the most economical trapezoidal canal section to carry a discharge of 20 cumecs with mean velocity of flow of 3.06 km/hr. Side slope of the canal is 1.5:1. Assume Bazin's constant, $K = 1.30$. Also calculate the allowable bed slope of the canal.

$$Q = 20 \text{ cumecs}$$

$$V = 3.06 \text{ km/hr} = 0.85 \text{ m/sec}$$

$$\text{Cross sectional area, } A = Q/V = 20/0.85 = 23.53 \text{ m}^2$$

Let base width of the canal be B and depth be D

Since side slope is 1.5:1, top width is $(B + 3 D)$

$$\text{Cross sectional area } A = (B + 1.5 D) D$$



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$$\text{Hence, } (B + 1.5 D) D = 23.53 \quad (\text{Eq.9.21})$$

**Wetted
perimeter,
P =**

$$B + 2 \left\{ \sqrt{D^2 + (1.5 D)^2} \right\} = B + 3.60 D$$

**Hydraulic mean
radius, R =**

$$\frac{(B + 1.5 D) D}{B + 3.60 D} \quad (\text{Eq.9.22})$$

$$\text{For economical canal section, } R = D/2 \quad (\text{Eq.9.23})$$

From Eq. (9.22) and (9.23),

$$\frac{D}{2} = \frac{(B + 1.5 D) D}{B + 3.60 D} \quad \text{Eq.(9.24)}$$



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Simplifying Eq. (9.24), we get $B = 0.60 D$ (Eq.9.25)

Putting the value of B from Eq. (9.25) in Eq. (9.21)
& simplifying $D = 3.35$ m, $B = 2.01$ m & $R = D/2 = 1.675$ m.

Bazin's Formula

$$C = \frac{87}{1 + \frac{K}{\sqrt{R}}}$$

Bazin's constant, $K = 1.30$ and $R = 1.675$

Chezy's constant, $C = 43.5$



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Chezy's formula is :

$$V = C \sqrt{R S}$$

$$\text{Hence, } 0.85 = 43.5 \times \sqrt{1.675 S}$$

$$S = 0.00022 = 0.022 \text{ percent} = 1:4374$$

Hence, base width & depth of canal are 2.01 and 3.35 m, respectively & bed slope is 0.022 percent.



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Design a canal section to carry discharge of 40 cumecs with mean velocity of flow of 3.42 km/hr. Side slope is 1:1. Ratio of base width to depth of flow in the section is given as $B/D = 6.5$. Assume value of coefficient of rugosity, $N = 0.0225$.

$$Q = 40 \text{ cumecs}$$

$$V = 3.42 \text{ km/hr} = 0.95 \text{ m/sec}$$

$$A = Q/V = 40/0.95 = 42.11 \text{ m}^2$$

Let base width of the canal be B and depth be D .

Since side slope is 1:1, top width is $(B + 2 D)$



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$$A = (B + D) D$$

$$\text{Hence, } (B + D) D = 42.11 \quad (\text{Eq. 9.26})$$

Given $B/D = 6.5$ which gives $B = 6.5 D$

Putting $B = 6.5 D$ in Eq. (9.26)

$D = 2.37$ m and hence, $B = 15.40$ m

Wetted perimeter, $P = B + 2\sqrt{2} D$

Putting $B = 15.40$ and $D = 2.37$, $P = 22.10$ m



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Hence, hydraulic mean radius, $R = 42.11 / 22.10$
 $= 1.90 \text{ m}$

Manning's Formula:

$$V = \frac{1}{N} R^{2/3} S^{1/2}$$

$R = 1.90$, $N = 0.0225$ (given), $V = 0.95$ (given)

and using Manning's formula we get
 $S = 0.000194 = 0.019$ percent = 1:
5155

So $B = 15.4 \text{ m}$, $D = 2.37 \text{ m}$ and $S = 0.019\%$.



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THANK YOU