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IRRIGATION ENGINEERING

[BTAI 2201]

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Economic Channel Section Design

The most economical channel section is one that gives maximum rate of discharge with a minimum cross sectional area.

For an economical channel section, the earth obtained from cutting can be fully utilized in forming the banks which is possible for a channel formed by partial cutting and partial banking.

For a given channel section, the discharge will be maximum when the mean velocity of flow is maximum.

For a given land slope, velocity will be maximum when the hydraulic mean radius is maximum i.e. wetted perimeter is minimum.

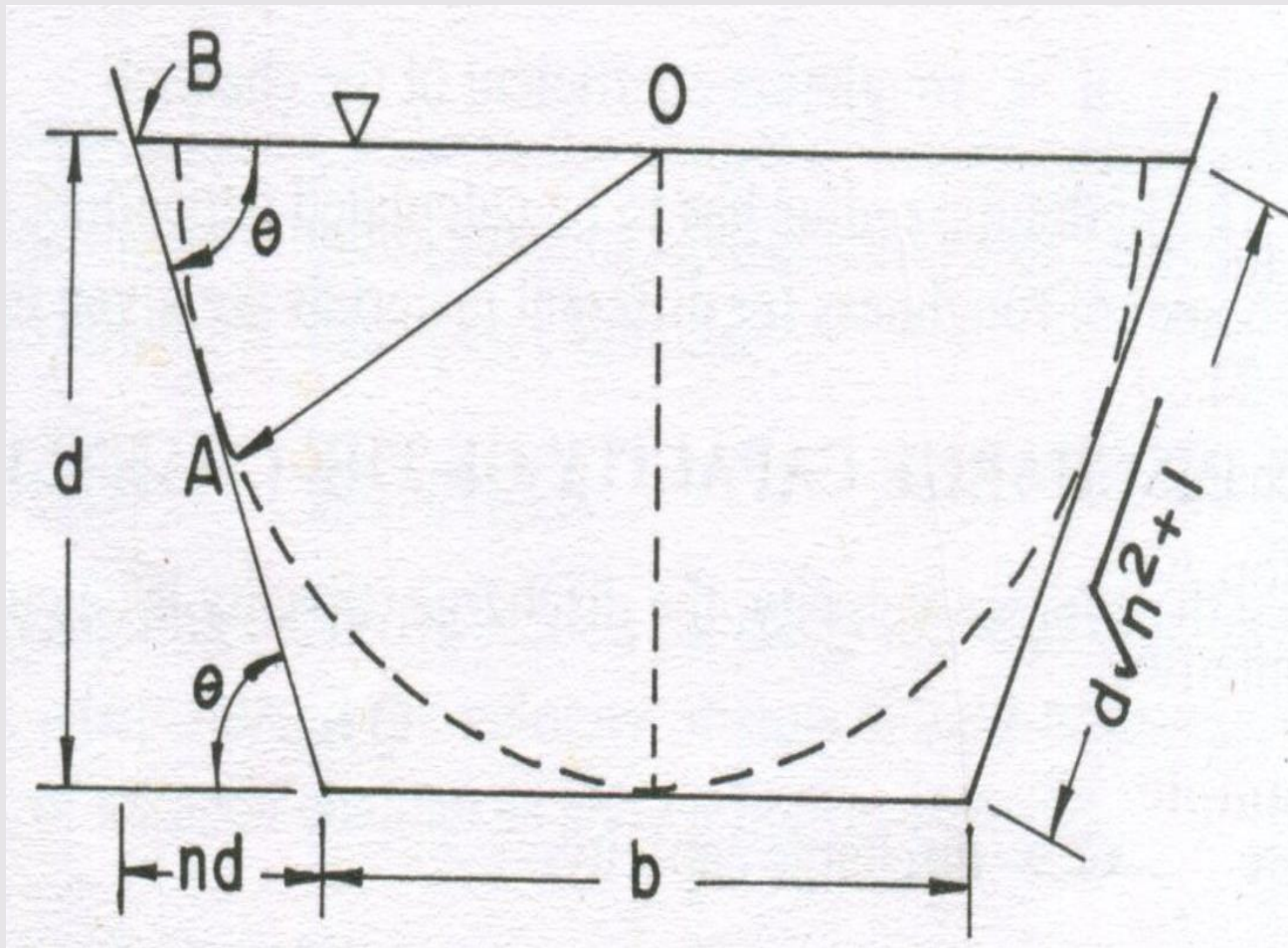
Theoretically, the most efficient cross section for an open channel is semi-circle.



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Economic Channel Section Design





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Let the side slope of the section be $n : 1$ (n horizontal to 1 vertical).

Now, $\tan \theta = 1/n$

Top width of the section = $(b + 2 n d)$ and sloping side = $d \sqrt{(n^2 + 1)}$

The wetted perimeter, $P = b + 2$

Cross sectional area, $A = (b + n d) d$

Hydraulic mean radius, $R = A/P =$

$$\frac{(b + n d) d}{[b + 2 d \sqrt{(n^2 + 1)}]}$$



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$$b = \frac{A}{d} - n d$$

$$P = \frac{A}{d} - n d + 2 d \sqrt{n^2 + 1}$$

For an economical channel section, P should be minimum and $dP/dd = 0$

Differentiating Above Eq. for P with respect to depth, d & equating it to zero gives

$$A = d^2 \left[2 \sqrt{n^2 + 1} - n \right]$$



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Economic Channel Section Design

Putting the value of A from above Eq. in to compute b and simplifying we get

$$b = d \left[2 \left(\sqrt{n^2 + 1} \right) - n \right] - n d$$

$n = \cot \theta$ Put $n = \cot \theta$ in above Eqn. and simplify

$$b = 2 d \tan \theta / 2$$



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Economic Channel Section Design

For economical rectangular section, putting $\theta = 90$, we get

$$b = 2d \text{ and } R = d/2$$

Hence, for the most economical rectangular channel section, depth of flow should be half of the base width or hydraulic mean radius is half of depth



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Unlined Canal design in Non-Alluvial Soil

Canals in non-alluvial soil have stable base. The coefficient of rugosity plays a major role in the design. But the silt factor has little role. Velocity of flow is close to critical velocity. So, the mean velocity given by Chezy's or Manning's equation can be applied for the design.



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THANK YOU