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Section-1

Ans-1 Specific Energy

(i) The total energy of a channel flow referred to a datum is given by,

$$H = Z + y\cos\theta + a(v^2/2g)$$

(ii) If the datum coincides with the channel bed at the section, the resulting expression is known as specific energy and is denoted by E. Thus

$$E = y\cos\theta + \alpha(v^2/2g)$$

when, $\cos\theta = 1$ and $a = 1$

$$E = y + (v^2/2g)$$

(iii) Hence specific energy of flowing liquid is defined as energy per unit weight of the liquid with respect to the bottom of the chanel.

Critical Flow Condition :

(i) For given discharge the condition for minimum specific force can be obtained by differentiating equation of specific force with respect to y and then considering it as $dF/dy = 0$

$$F = Q^2/gA + A\bar{z} \quad \text{——— (1)}$$

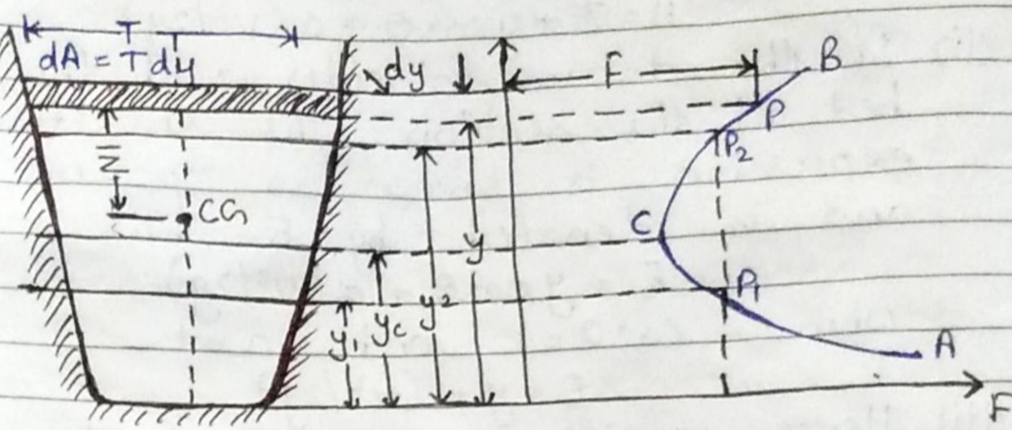
(ii) Differentiate of Eq. (1) with respect to we get

$$\frac{dF}{dy} = -\frac{Q^2}{gA^2}\frac{dA}{dy} + \frac{d(A\bar{z})}{dy} = 0 \quad \text{——— (2)}$$

(iii) Since Q is constant and both A and $\bar{z}$ are the function of y. As shown in fig. for a change dy in the depth, the

Corresponding change $d(A\bar{z})$ in the moment of the cross-sectional area about the ~~force~~ free surface may be expressed as,

$$\frac{d(A\bar{z})}{dy} = \left[A(\bar{z} + dy) + T\,dy\,\frac{dy}{2}\right] - A\bar{z}$$



(iv) Neglecting smaller term, $\frac{T(dy)^2}{2}$ we get

$$d(A\bar{z}) = A\,dy$$

(v) Substituting this value of $d(A\bar{z})$ is eq (2) we get

$$\therefore \frac{dF}{dy} = -\frac{Q^2}{gA^2}\frac{dA}{dy} + \frac{A\,dy}{dy} = 0$$

(vi) Again since $(dA/dy) = T$, the above eq. reduces

or $$\frac{Q^2 T}{gA^2} = 1 \qquad \left[\because \frac{dA}{dy} = T\right]$$

(vii) The above condition is critical flow condition. Thus it can be said that at critical depth, specific force attains minimum value.