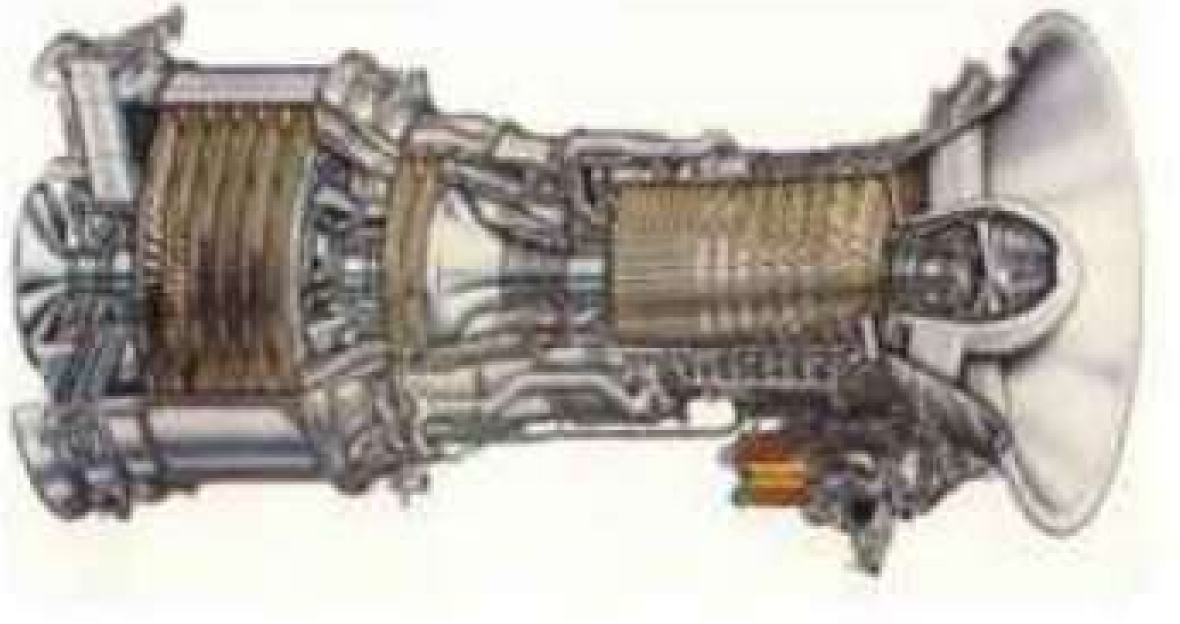
REVISED NINTH EDITION

A Textbook of

FLUID MECHANICS AND HYDRAULIC MACHINES

S.I. Units



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16.5.1 Most Economical Rectangular Channel. The condition for most economical section, is that for a given area, the perimeter should be minimum. Consider a rectangular channel as shown in Fig. 16.9

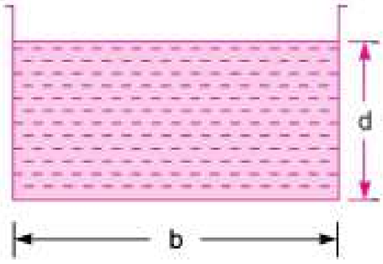

Fig. 16.9 *Rectangular channel.*

Let b = width of channel,

d = depth of the flow,

$\therefore$ Area of flow, $A = b \times d$ ...(*i*)

Wetted perimeter, $P = d + b + d = b + 2d$ ...(*ii*)

From equation (*i*), $b = \frac{A}{d}$

Substituting the value of b in (*ii*),

$$P = b + 2d = \frac{A}{d} + 2d \quad \text{...(iii)}$$

For most economical section, P should be minimum for a given area.

or $$\frac{dP}{d(d)} = 0$$

Differentiating the equation (*iii*) with respect to d and equating the same to zero, we get

$$\frac{d}{d(d)}\left[\frac{A}{d} + 2d\right] = 0 \quad \text{or} \quad -\frac{A}{d^2} + 2 = 0 \quad \text{or} \quad A = 2d^2$$

But $A = b \times d$, $\therefore$ $b \times d = 2d^2$ or $b = 2d$ ...(16.9)

Now hydraulic mean depth, $m = \frac{A}{P} = \frac{b \times d}{b + 2d}$ $(\because \; A = bd, P = b + 2d)$

$$= \frac{2d \times d}{2d + 2d} \qquad (\because \quad b = 2d)$$

$$= \frac{2d^2}{4d} = \frac{d}{2} \qquad \text{...(16.10)}$$

From equations (16.9) and (16.10), it is clear that rectangular channel will be most economical when:

(*i*) Either $b = 2d$ means width is two times depth of flow.

(*ii*) Or $m = \frac{d}{2}$ means hydraulic depth is half the depth of flow.