PROBLEM 4.1

A uniform critical flow is to occur in a rectangular channel of 6.00m width at most economical section what would be the channel slope? (n=0.017)

SOLUTION

b=6.0m & n= 0.017

the most economical section has b=2y

then, $y_c = 6.0/2 = 3.0$ m

$$y_c = \sqrt[3]{\frac{q^2}{g}} \quad \therefore \quad 3.0 = \sqrt[3]{\frac{q^2}{9.81}}$$

$$q = 16.27\, m^3/s/m$$

$$Q = q \times b = 16.27 \times 6.00 = 97.65\, m^3/\text{sec}$$

$$Q = \frac{1}{n} A R^{2/3} S^{1/2}$$

$$97.65 = \frac{1}{0.017}(18.0)\left(\frac{18.0}{12}\right)^{2/3} S^{1/2}$$

$$\therefore \quad S = 0.005$$

PROBLEM 4.3

A discharge of 530 cfs is carried by a trapezoidal channel 11.0ft wide, 1:1 side slopes. Evaluate the Froude number when the specific energy is 8.45ft.

SOLUTION

$$E = y + \frac{V^2}{2g} = y + \frac{Q^2}{2gA^2}$$

$$8.45 = y + \frac{(530)^2}{2x32.2(11y + y^2)^2}$$

by trial and error the two alternate depths are

$y_1 = 8.27'$ and $y_2 = 2.0'$

$$F = \frac{V}{\sqrt{gy_n}}$$

For y=8.27 ft

$A=8.27(11+8.27)=159.36\ ft^2$

$V=Q/A=530/159.36=3.33\ ft/s$

$T=11+2*8.27=27.54\ ft$

$y_n=A/T=159.36/27.54=5.79\ ft$

$F=3.33/(32.2\times5.79)^{1/2}=0.24<1.0$ (subcritical flow)

For y=2.0 ft

$A=2.0(11+2.0)=26.0\ ft^2$

$V=Q/A=530/26.0=20.38\ ft/s$

$T=11+2\times2.0=15.0\ ft$

$y_n=A/T=26.0/15=1.73\ ft$

$F=20.38/(32.2\times1.73)^{1/2}=2.73>1.0$ (super-critical flow)