3.9.2 Typical tidal drainage sluice

Design data:

Drainage basin area	:	1300 hectares
Maxm. riverside monsoon water level (average design conditions)	:	2.70 meter (PWD)
Minm. riverside monsoon water level (for average design condition)	:	(-) 0.60 meter (PWD)
Bed level of natural channel at the proposed site	:	(-) 0.30 meter (PWD)
Bed width of natural channel at the proposed site	:	8.0 meter
Average ground level of the basin	:	1.20 meter (PWD)
Rainfall excess (1 in 10 year)	:	45.70 millimeter/day
Embankment crest level	:	4.88 meter (PWD)

Sluice Size Determination (approximate method)

Design countryside water level = 1.5 meter (average GL + 0.3 m)
Tidal range is 3.30 meter in 6 hour
Assuming a linear water level fluctuation, the water level rises or falls at a rate of 0.55 meter per hour.
Invert level of the sluice is at (-) 0.60 meter PWD
Ratio of head water depth to barrel height (Hw/D) = 2.1/1.83 =1.15
Discharge per unit barrel width (Q/b) from design chart (Fig. B-11 Page 588 Design of Small Dam, Third Edition) is 4.66 m^3/sec/ m (50 ft^3/sec/ft)
Total discharge for a box, 1.52 meter wide = 4.66 x 1.52 = 7.08 m^3/sec
For rectangular section critical depth $y_c = (q^2/g)^{1/3}$

$$y_c = (4.66^2/9.81)^{1/3} = 1.30 \text{ meter}$$

The sluice will be discharging in inlet-control as long as the tailwater is at or below the elevation,

$(yc + D)/2 = (1.30 + 1.83)/2 = 1.57$ meter (tail water el.+ 0.97 meter)

Discharge in inlet control would remain constant at 7.08 cubic meter per sec as the headwater is assumed constant. From the elevation of 0.97 meter PWD to 1.50 meter PWD, the control will be shifted to outlet and the discharge will linearly be reduced to zero as shown in figure 27.

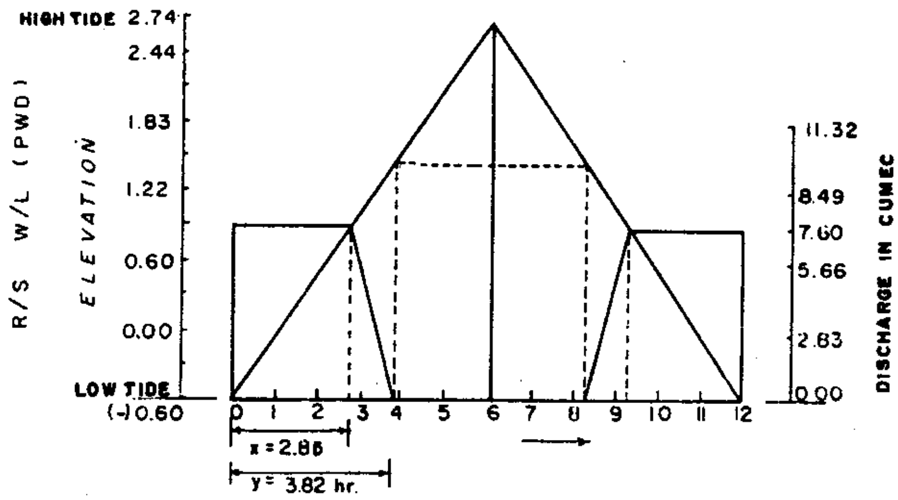

Fig. 27. Tidal Discharge Curve

Drainage is constant, by similar triangles, for a period

$t_1 = (6/3.3) \times 1.57 = 2.85$ hour

Drainage reaches a discharge rate of zero from change of tide to tide blockage. $t_2 = (6/3.3) \times 2.1 = 3.82$ hour

Volume of water discharged under one drainage curve in 12 hours

$$V = \left[2\,(2.85 \times 7.08) + \frac{2\,(3.82 - 2.85) \times 7.08}{2}\right] \times 3600$$

$= [\ 40.35 + 6.87\ ]\ 3600$

$= 169992$ cubic meter in 12 hours

$= 339984$ cubic meter per day

$= 3.94\ m^3/sec$

Therefore average discharge for 24 hours period by one vent 1.52 m x 1.83 m sluice is 3.94 cubic meter per second.

45.7 millimeter of rainfall excess over an area of 1300 hectares will generate a total drainage discharge for the basin

(45.7/1000) x 1300 x 10000 = 594100 cubic meter per day

So the number of vents required = 594100/339984 = 1.75

Provide a 2 vent 1.52 m x 1.83 m for the drainage basin.

3.9.3 Typical Water Retention Structure

A water retention structure is to be constructed on a channel with the following design parameters.

Natural Bed Width	:	20 meter
Natural Depth of Channel	:	3 meter
Side Slopes	:	2:1 (H:V)
Discharge (bankful)	:	70 cumec

The channel is perennial and the structure will retain water in lean period for winter irrigation to cultivable land bordering the channel. The structure will be designed to permit little or no backwater effect upstream of the structure during flood flow. The following calculation determines the minimum opening required to pass the flood discharge through the structure.

Hydraulic Design Steps

For a channel flowing at a discharge of 70 m^3 /sec and a depth of flow 3.0 meter, the average velocity in the cross section is 0.9 m/sec

$$\text{Specific energy of flow (E)} = y + \frac{v^2}{2g} \qquad \text{.....(10)}$$

$$= y + \frac{Q^2}{2g\ A^2}$$

in which

y = depth of flow from mean bed level

Q = discharge is m^3/sec

A = cross-sectional area (m^2)

g = gravity acceleration (9.8 m/sec^2)

E = specific energy in meter above bed level

$$\text{Thus} \quad E = 3.0 + \frac{(70)^2}{2x9.8x(78)^2}$$

$$= 3.04 \text{ meter}$$

Compute the minimum width of a rectangular and a trapezoidal section which will convey this flow without "chocking" the flow. For the rectangular section the procedure is :

Assuming critical depth will occur at the constriction and the depth of flow "y_c" is then two-thirds of the specific energy of the flow upstream. Thus y_c = 2/3 x 3.04 = 2.03 meter

For rectangular channels