

Practical No: 2

Design of Graded Bund

Aim: Design of graded Bund

Theory: Graded bund is designed based on 1h rainfall intensity for desired recurrence interval. In general, a grade of 0.2 to 0.3% is provided in graded channel. In graded bund free board of 15 to 20% of desired depth is provided.

Recommended Dimension

Height of bund ≤ 45 cm

Top width = 30 to 90 cm

Velocity of runoff should be less than critical velocity.

Table 2.1 Recommended side slope for graded bund (Source: Das,2002)

<i>Type of soil</i>	<i>Side slope (horizontal : vertical)</i>
Clayey	1 : 1
Loamy	1.5 : 1
Sandy	2 : 1

Table 2.2 Recommended seepage line slope for graded bund (Das, 2002)

<i>Type of soil</i>	<i>Seepage line slope (horizontal : vertical)</i>
Clayey	3 : 1
Sandy loam	5 : 1
Sandy	6 : 1

(1) Calculation of Vertical Interval (VI) and Horizontal Interval (HI)

For medium to high rainfall areas:

$$VI = 0.1s + 0.6 \quad (m)$$

$$\text{and } \frac{s}{100} = \frac{VI}{HI}$$

$$\text{then, } HI = \frac{VI \times 100}{s} \quad (m)$$

Where,

V.I = Vertical interval, m

H.I = Horizontal interval, m

s = Original land slope, %

(2) Calculation of Peak Runoff Rate:

$$Q_P = \frac{CIA}{360} \quad \left(\frac{m^3}{s} \right) \quad \text{by Rational formula}$$

Where,

Q_P = Peak runoff rate (m^3/s)

C = Runoff coefficient

I = Rainfall intensity (mm/h) for duration equal to time of concentration.

$$t_c = 0.0195 \left(\frac{L}{\sqrt{S}} \right)^{0.77} \quad \text{in minute}$$

Where,

t_c = Time of concentration (min)

L = Length of water flow = (length of bund + distance between two bunds) in (m)

S = H/L = gradient or slope causing water flow

H = Elevation difference causing water flow

= (elevation difference causing length of bund + elevation difference of land)

= (L X g + HI X s) (m)

g = grade of channel (%)

A = Drainage area (ha)

= (L X HI)

(3) Calculation of Discharge Capacity of Graded Bund

$$\text{Hydraulic radius } (R) = \frac{A}{P} \quad (m)$$

$$\text{Mean velocity } (v) = \frac{1}{n} \times R^{\frac{2}{3}} \times g^{\frac{1}{2}} \quad \text{in } \left(\frac{m}{s}\right) \quad \text{by Mannings equation}$$

where,

n = Manning's roughness coefficient

$$\text{Discharge capacity } (Q) = (a_1 + a_2) \times v \quad \text{in } \left(\frac{m^3}{s}\right)$$

if $Q > Q_p$ then the design is proper

(4) Calculation of Bund Dimension

$$\text{Total height of the bund } (H) = (d + 20\% \text{ of } d \text{ as freeboard}) \quad (m)$$

$$\text{Base width } (B) = (nd + 5d) \quad (m)$$

$$\text{Top width } (T) = (B - 2nH) \quad (m)$$

(5) Calculation of Earth Work due to Bunding

$$\text{Length of contour bund per ha } (L) = \frac{10^4}{HI}$$

Earthwork per ha = cross sectional area of bund \times length per ha

$$= \left[\frac{1}{2} \times (B + T) \times H \right] \times L \quad \left(\frac{m^3}{ha}\right)$$

NUMERICALS:

Question:

A 350m long graded bund has been proposed to construct on a land of 3% slope. The type of soil is sandy. The rainfall intensity of the area was recorded as 18 cm/hr for the duration equal to time of concentration. The grades to be maintained are as follows:

- i) 1st 50m length=0.1%
- ii) 2nd 150m length= 0.15%
- iii) 3rd 150 m length =0.2%

Determine the dimension of bund?

