

ROHINI COLLEGE OF ENGINEERING AND TECHNOLOGY



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COLLEGE OF ENGINEERING AND TECHNOLOGY

Approved by AICTE and affiliated to Anna University, (An ISO Certified Institution)

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DEPARTMENT OF AGRICULTURAL ENGINEERING

AI3402 SOIL AND WATER CONSERVATION ENGINEERING

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AI3402 SOIL AND WATER CONSERVATION ENGINEERING

3.3 Introduction

Bunding is an engineering soil conservation measure used for retaining water and creating obstruction to the surface runoff for controlling soil erosion. Bunds are simple earthen embankments of varying lengths and heights, constructed across the slope. When they are constructed on the contour of the area, they are called as contour bunds and when a grade is provided to them, they are known as graded bunds. For bunding, the entire area is divided into several small parts; thereby the effective slope length of the area is reduced. The reduction of the slope length causes not only reduction of the soil erosion but also retention of the runoff water in the surrounding area of the bund. Bunds are similar to the narrow based terrace, but no agricultural practices are done on bunds except at some places, where some types of stabilization grasses are planted to protect the bund.

Types of Bunds

Bunds are of two types: (1) Contour bund and (2) Graded bund

(1) Contour Bund

When the bunds are constructed following the same contour, they are called contour bunds. Fig 1.1 shows the layout of contour bunds in the field. Contour bunds are recommended for areas with low annual rainfall (<600 mm), agricultural field with permeable soil and having a land slope < 6%. The major requirements in such areas are prevention of soil erosion and conservation of rain water in the soil for crop use.

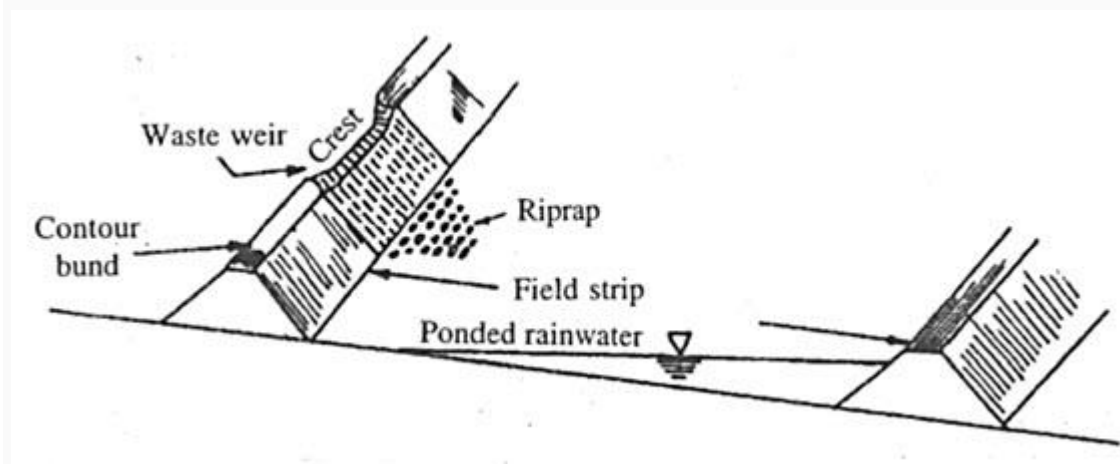


Fig. 1.1. Layout of contour bunds in field. (Source: Das, 2002)

Contour bund absorbs the runoff water stored at the upstream side of the bund. Proper height of the bund is necessary to avoid overtopping during floods. During monsoon, even in a low rainfall region, the entire runoff water cannot be stored and the excess is liable to flow over the bund. To avoid damage, waste or surplus weir (Fig. 1.2) is provided on the bunds to dispose off excess water into the next bund. This prevents water-logging.

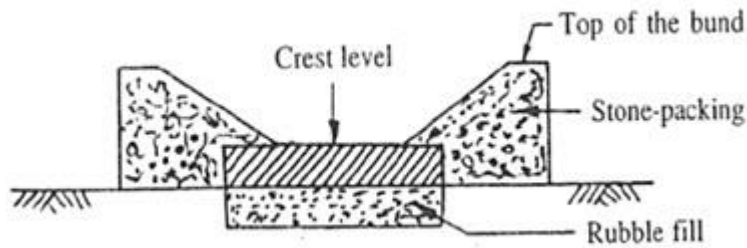


Fig. 1.2. Clear overfall stone weir. (Source: Das, 2002)

Contour bunding can be adopted on all types of permeable soil except for the clayey or deep black cotton soils as these soils have the problem of crack development causing bund failure. Clayey soil also has the problem of water-logging near the bund section, which makes the bund construction infeasible.

(2) Graded Bund

When a grade is provided along the bund for safe disposal of runoff water over the area between two consecutive bunds, they are called graded bund. Graded bunds are adopted in case of high or medium annual rainfall (>600 mm) and relatively less permeable soil areas. Graded bunds are designed to dispose excess runoff safely from agricultural field.

Design of Bunds

Design of Contour Bund

The design parameters required for contour bunds are

- (1) Vertical interval
- (2) Horizontal interval
- (3) Bund cross-section
- (4) Earth work due to bunding

Height of the contour bund should be enough to store the expected peak runoff for a 10 years recurrence interval. A free board of about 20% should be provided for the settlement of height.

(1) Calculation of Vertical Interval (V.I) and Horizontal Interval (H.I)

For low rainfall areas

$$VI = 0.15s + 0.6 \quad (m)$$

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

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

Where,

VI = Vertical interval, m

HI = Horizontal interval, m

s = Original land slope, %

(2) Calculation of Storage Required for Runoff Volume

$$P_e = P - I \quad (m)$$

$$A = HI \times L \quad (m^2)$$

So, runoff volume to be stored (R_V)

$$R_V = P_e \times A \quad (m^3)$$

Where,

P = Precipitation, m

P_e = Excess rainfall depth or surface runoff, m

I = infiltration depth, m

H.I = Horizontal interval, m

L = Length of bund behind which the runoff is stored, m

A = Area of watershed behind two bunds, m^2 .

R_V = Runoff volume to be stored, m^3 .

(3) Calculation of Storage Volume

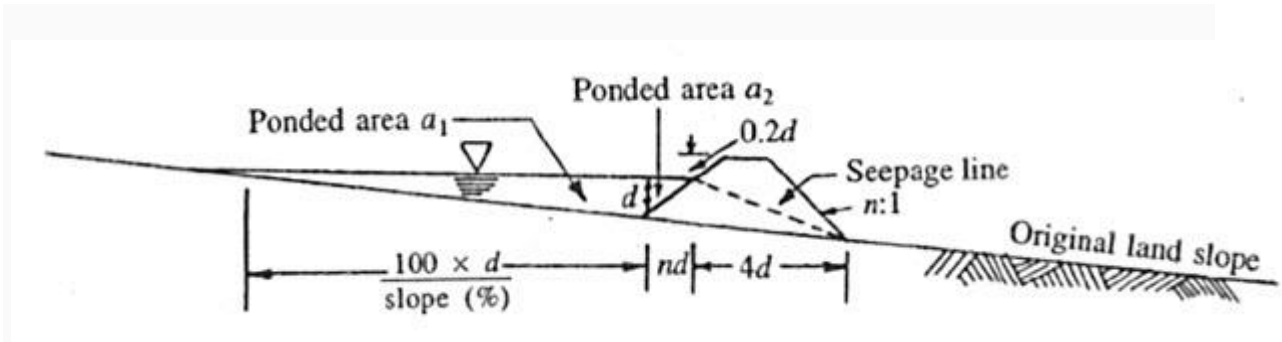


Fig. 24.3. Layout of contour bund. (Source: Das, 2002)

From the above layout of contour bund (Fig. 24.3),

$$\text{Pounded area } (a_1) = \frac{1}{2} \times \frac{100d}{s} \times d \quad (m^2)$$

$$\text{Pounded area } (a_2) = \frac{1}{2} \times nd \times d \quad (m^2)$$

$$\text{Area of water stored behind the bund} = (a_1 + a_2) \quad (m^2)$$

Storage volume (S_v) = area of water stored behind the bund \times length of bund (m^3)

where,

d = depth of water stored behind the bund (m)

$n : 1$ (H:V) = side slope of the contour bund

$4:1$ (H:V) = Seepage line slope of the bund

(4) Calculation of Depth of Water Stored Behind Bund

For total runoff absorbed by the bund,

Runoff volume (R_v) = Storage volume (S_v)

Using this relationship, the depth of water stored behind bund is calculated.

(5) Calculation of Bund Cross Section

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

$$\text{Base width } (B) = (nd + 4d) \quad (m)$$

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

(6) Calculation of Earth Work due to Bunding

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

$$= \frac{10^4}{HI} \times 1.3 \text{ for main bund with side and lateral bund}$$

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

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