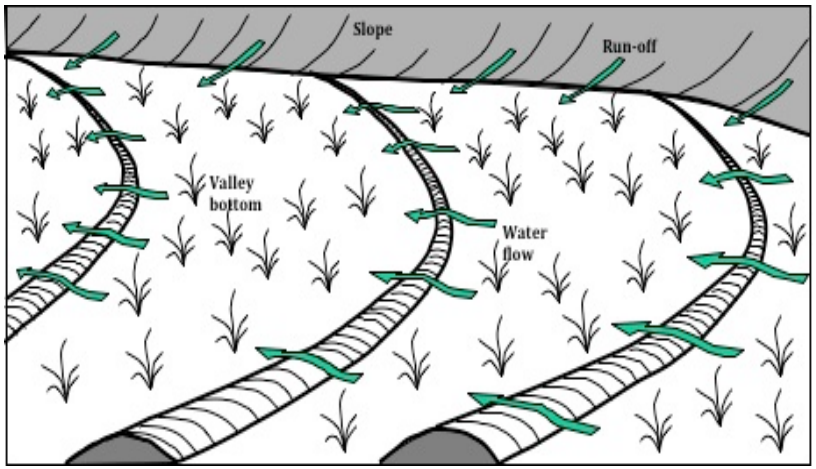
Bunding

It is an engineering soil conservation measure, used for retaining water, creating obstruction, and thus controlling soil erosion or soil loss. When they are constructed on the contour of the area, are called **contour bund** and when grade is provided to them, then they are known as **graded bund**. In bunding practice, the entire area is divided into several small parts, thereby the effective slope length of the area is reduced. The reduction in slope length causes not only to reduce the soil erosion but also retain the runoff water in the surrounded area of the bund. Contour bunds are used in low rainfall areas for the purpose to control the soil erosion and to store rain water, while the graded bunds are constructed in relatively medium to high rainfall area for the same purpose as the contour bunds.

Contour Bunding

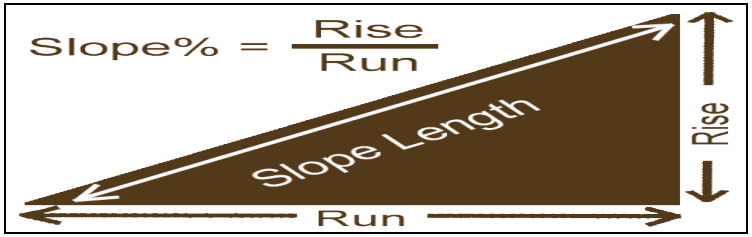
What?

The bunds passing through the points of equal elevation (i.e. on contour) of the land are known as contour bunding



Why?

- It reduces the length of slope, which in turn to reduce soil erosion



- Impounds the water at u/s portion, and permits more water to get recharged into the soil that is utilized for crop cultivation

Where?

- In all types of soils except deep black cotton soils
- In areas where annual rainfall does not exceed 800 mm
- In arid and semi-arid areas where soils are of high infiltration and permeability
- It is commonly used on agricultural land up to 10% slope

What are the structural Components?

- Borrow pit
- Berm
- Weir
- Main Bund

Let us understand design of contour bunding by example

1 Hectare = 10,000 square meters 1 Hectare = 2.471 acres

Problem: A piece of land measuring 1350 m along the slope and 250 meters across the slope has a uniform slope of 2 %.The maximum 24 hour rainfall for 10 years recurrence interval is 200 mm. The soils are sandy loam in texture and having a good infiltration rate. Design the cross section of the main bund if the top width of the bund is 0.5m. The side bunds are to be taken up to the slopes of 0.5 m above the main bund line. Find the earth work of bund.

Solution:

(1) Area to be brought under construction of contour bunding: 1350 m x 250m = 337500 square meters = 33.75 hectares = 83.40 acres

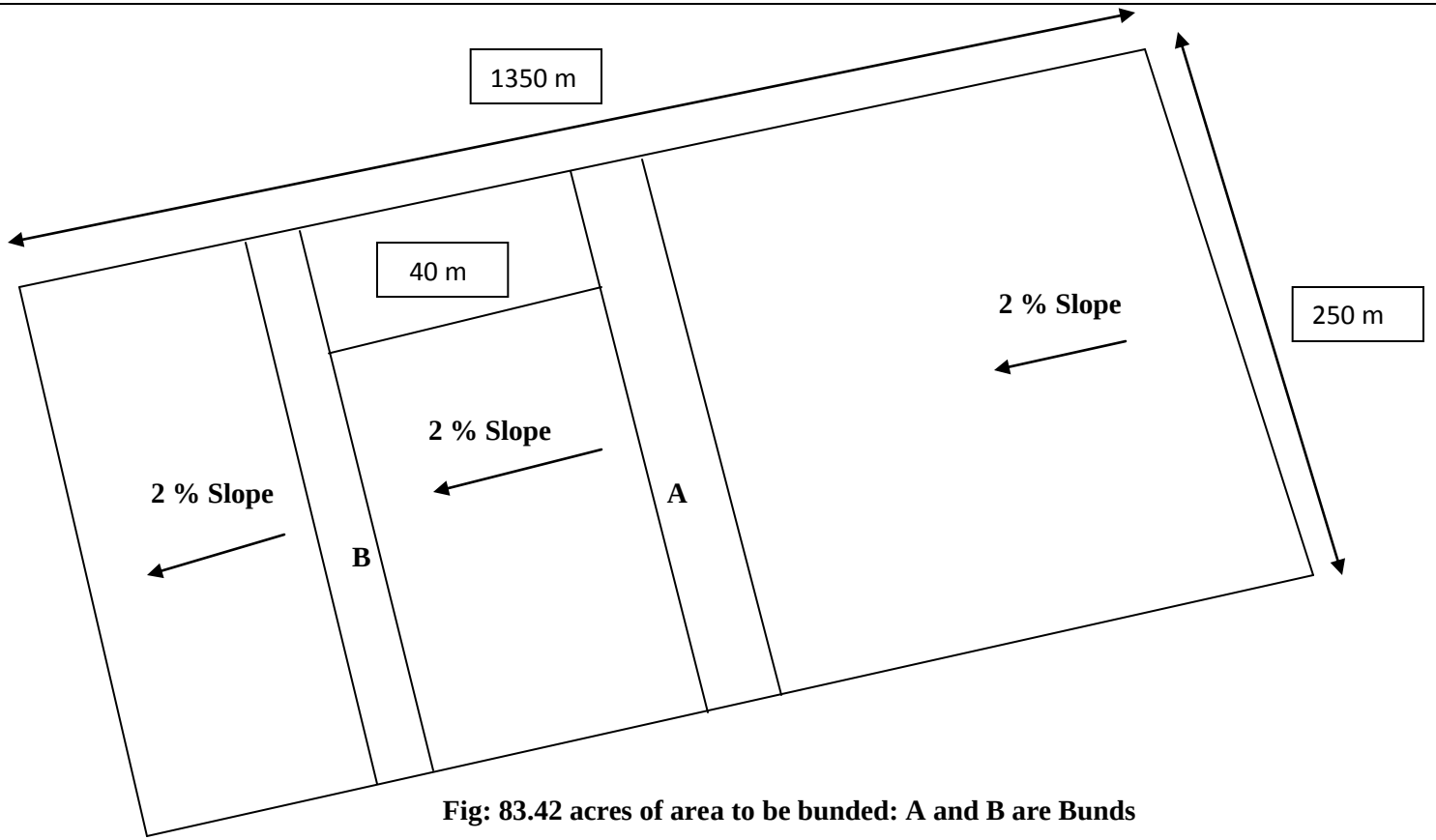


Fig: 83.42 acres of area to be bunded: A and B are Bunds

(2) Now we have to determine following parameters

- Volume of earth work for the main bund

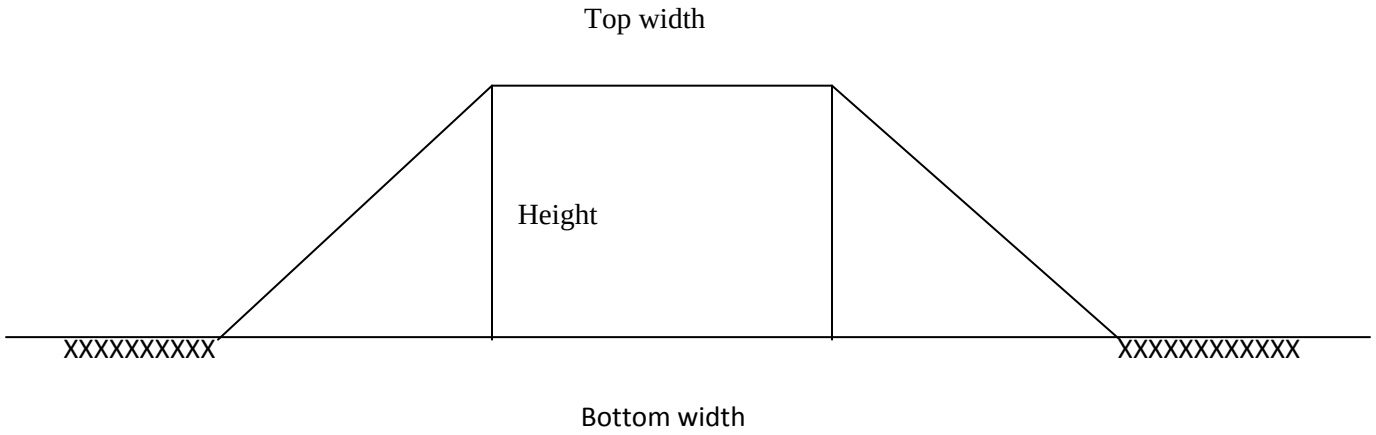
Volume of earth work for the main bund = Total length of the bund for the area to be bunded x Cross sectional area of bund

- Total length of the bund for the area to be bunded

Total length of the bund for the area to be bunded = Length of the bund per hectare x Total area to be bunded (in hectares)

- Cross-sectional area of bund

Cross-sectional area of bund =((Top width + Bottom width) / 2) * Height



Note: In general, a minimum of 0.3 to 0.6 m width is kept to facilitate planting of grasses on the top of the bund.

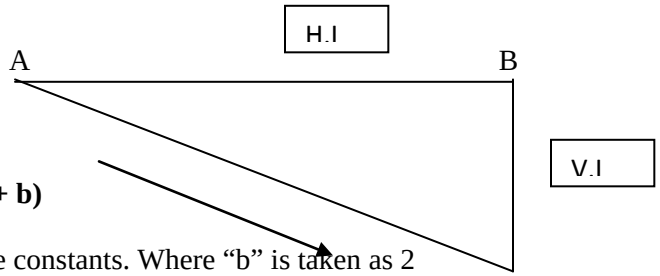
Stylosanthes Hamata grass is grown on the bund

- **Height of bund (h)**

Height of the bund (h) is decided for a 30 cm depth of impounding which is a usual practice in many states. The design of bund for 30 cm depth of impounding is an arbitrary design. The height of bund to impound run off from 24 hours storm is calculated as follows

$$h = \sqrt{Re \times VI/50}$$

Where, Re is 24 hour rainfall for 10 years recurrence interval and VI = Vertical Interval



Vertical Interval (V.I) = 0.3 (S/a + b)

Where, S is the land slope, a & b are constants. Where "b" is taken as 2

For soils with good infiltration rates, the value of "a" is taken as 3 and for soils with low infiltration rates, the value of "a "is taken as 4.

Infiltration rate

Low infiltration rate less than **15 mm/hour;** medium infiltration rate **15 to 50 mm/hour;** high infiltration rate more than **50 mm/hour.**

- **Obtain rainfall data from nearest Rain Gauge Station and find out the maximum - 24 hour rainfall occurred in 10 years recurrence interval.**

- **Horizontal Interval**

  H.I = 100 V.I/S

- **Number of Bunds (N)**

  N = Length of the field / H.I

- **Freeboard (f)**

  Minimum of 10 cm is provided as free board.

- **Bund side slopes**
- **Cross section of Bund**

Given value in the problem **Cross-sectional area of bund =((Top width + Bottom width) / 2) * Height**

Side slope ratio for sandy loam soils is 1.5:1

Height of the bund (h) = $\sqrt{\text{Re x VI/50}}$

Vertical Interval (V.I) = 0.3 (S/a + b)

S = 2%

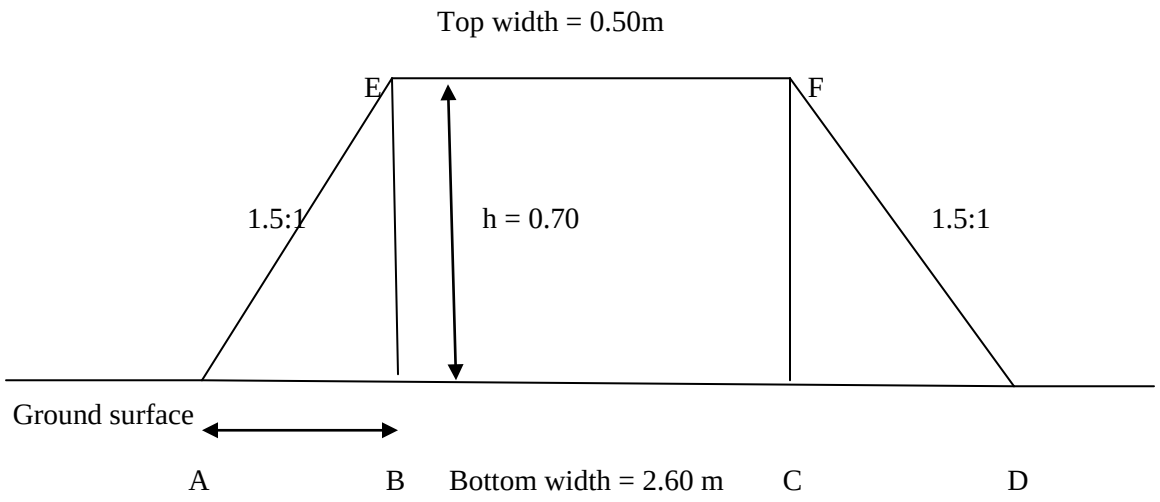
Since the given soils are having good infiltration rate, value of **"a"** = 3 and **"b" = 2**

V.I = 0.3(2/3 + 2) = 0.80 m

Re is given as 200mm = 20cm

h = $\sqrt{20x0.80/50}$ = 0.57 m

Actual height of bund after adding freeboard = 0.57 + 0.10 = 0.67 = 0.70m



Bottom width = AB + BC + CD

Here EF = BC = 0.50 m

AB = h x 1.5 = 0.70 x 1.5 = 1.05 m

CD = h x 1.5 = 0.70 x 1.5 = 1.05 m

Bottom width = AB + BC + CD = 1.05 + 0.50 + 1.05 = 2.60 m

Cross-sectional area of bund = ((Top width + Bottom width) / 2) * Height

= ((0.50 +2.60)/2) * 0.70

= (3.10/2)*0.70 = 1.55 *0.70 = 1.085 m2

Total length of the bund for the area to be bunded = Length of the bund per hectare x Total area to be bunded (in hectares)

Length of the bund per hectare = 100 S/VI = 100x2/0.80 = 250 m

Total area = 33.75 ha

Total length of the bund for the area to be bunded = Length of the bund per hectare x Total area to be bunded (in hectares)

= 250 x 33.75 = 8437.5 m

Volume of earth work for the main bund = Total length of the bund for the area to be bunded x Cross sectional area of bund

= 8437.50 m x 1.085 m2 = 9154.6875 m3 = 9155 m3

- **Volume of earth work for side bunds = Total length of side bunds x cross sectional area of side bund**

Number of Contour Bunds (N)

N = Length of the field / H.I = 1350/40 = 34 No.s

Number of side bunds = 2x 34 = 68 No.s

Length of side bund = 100 x d/2

Where d is the elevation difference between the end point of side bund and contour bund

Given value of “d” = 0.5 m

= 100 x 0.5 /2 = 25 m

Total length of all side bunds = 68 x 25m = 1700 m

Cross sectional area of side bund is usually taken as 2/3 rd of the main bund

= 2/3 x 1.085 m2 = 0.7233 m2

Volume of earth work for side bunds = Total length of side bunds x cross sectional area of side bund

= 1700 m x 0.7233 m2 = 1299.61 m3 = 1230 m3

Total volume of earth work for main and side bunds = 9155 + 1230 = 10385 m3

Construction steps

- Layout for construction should be started from top of the catchment.
- A horizontal line along the slope is marked at one end of the field.
- Using a pipe level, contour line is demarcated up to the end of the field.
- Next line for contour bund is demarcated on the line with elevation difference equal to vertical interval.
- Soil for construction of bunds should be taken from burrow pits of suitable chosen size.
- Size of burrow pits should be as per required volume of earth required for bund.
- Normal size of burrow pit is 3 x 3 x 0.3 m or 3 x 3 x 0.45 m.
- Burrow pit should not be continuous, but interrupted with a gap of 0.6 m.
- A space of 0.3 m is provided as the gap between the bund and burrow pit which is called as berm.
- All bunds from the top are constructed to their full sections.
- All the burrow pits should be uniform in size and the berm gap should be uniform.
- Ramps are provided for the free passage of cattle, implements etc. on the bund.

- Suitable vegetation protection must be provided to ensure stability of the bund.

Contour Bunds: DO's and DONT's

i. Always provide a berm (distance from excavated portion to bund) of minimum 30 cm.

ii. Always provide a settlement allowance of 10-15% depending on soil type.

iii. Exit must be provided in sloping land and in impermeable soils, depending on site conditions.

iv. In impermeable soils increase the cross section area of bunds.

v. Do not start the lay-out of bunds from the shorter section. Always begin from the longest section within the largest area of uniform slope.

vi. Do not make bunds on slopes higher than 10%. On relatively high slopes do not make bunds closer than 30 m.

vii. On low slopes do not make bunds farther than 60 m.

viii. Do not construct bunds where there is already dense vegetation.

ix. Do not excavate if roots of a tree are encountered

x. Do not excavate soil continuously in permeable soils.