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ESTIMATION FOR QUANTITY OF EARTHWORK IN CONSTRUCTION OF GRADED BUND

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Abstract: Soil erosion mainly occurs on sloping ground and are difficult to manage resulting in soil loss. Due to slope most of the area remains uncultivated. Storage of water is also a major issue in sloping land. The Imaliya farm site located in jabalpur has also such conditions due to which major portion of the land remains unused. The research aims to provide suitable design of graded bund and the quantity of earthwork required to construct the bund at Imaliya farm site for better utilization of rainfall and crop production.

Key words: Soil erosion, runoff, bund, earthwork

Introduction

The top most layer of earth consists of soil having different properties suitable for cultivation purposes. The use of this layer of soil up to certain depth is required for crop production. Due to open availability the soil is always affected by weathering action resulting in changes in topography and sometimes in index properties. Wind and water are the two main forces which adversely affect the soil. Water in less quantity doesn't allow the crop growth whereas in abundance damage the crop too, so there is always a need to provide adequate amount of water to sustain crop. Wind on the other hand transports the soil from one place to another resulting in soil erosion. The sloping lands are highly affected by wind action because of instability of soil particles. For addressing such problem various engineering measures has been taken, out of which bunds are adopted mostly. There are various types of bunds to be constructed but it is seen that on sloping ground contour bunds have proved to be more effective on retaining soil and storing water for cultivation purposes. These bunds can be used on sloping ground having slope up to 10% effectively. Contour bunds are used in low rainfall i.e rainfall less than 600m whereas graded bund can be used in high rainfall area i.e rainfall greater than 700 mm.

Detail of Imaliya Farm:

The farm is under usage of Jawaharlal Nehru Agricultural University. It has large area of around 17 acres. Most of the land is in slope varying from 3 to 5 %. The farm has majorly clay soil. Due to slope most of the rain water gets washed away during rainy season and there are limited source of water supply due to which scarcity of water is always there. Small marginal farmers reside in that area and their income depends mainly on agricultural production.

The rainfall data was collected by Free Press Journal 2023 report according to which the average 24 hour excess rainfall is around 15cm and average annual rainfall is approximately 133.1cm.

Methodology for the design of graded bund

The proposed design is based on the methodology given by Dr R Suresh in "Water harvesting and soil conservation structures". Due to rainfall greater than 600 mm, graded bund was considered for design. The design of graded bund deals with the primary calculation of vertical interval and horizontal interval to fix the bund positions. Then the length of bund was carried out. Since the runoff water gets accumulated behind the bund it is necessary to calculate the depth of water impounding behind the bund. For the proper dimension of bund it is necessary to calculate the peak discharge and discharge capacity of bund. After satisfying the criteria, dimension of bunds are calculated and with respect to dimension of bund calculation of earthwork is done.

The side slope of bund is taken as 2:1 and the slope of seepage line is 5:1.

Slope (S) of land is 5%

Manning's roughness coefficient (n) is taken as 0.04

Runoff coefficient (C) is taken as 0.35

Impounding water depth is given by the formula

Overflow of weir is taken as 30cm

Result and Discussion: following criteria was adopted in calculation of graded bund

Vertical interval: The vertical interval is given by

VI = (0.1S+0.6) = 1.1 m

Horizontal interval: The horizontal interval of the graded bund is given by

HI = $\frac{VI \times 100}{S}$ = 22 metres

Peak runoff rate: It is given by the formula

$Q_p = \frac{CIA}{360} = 1.47 m^3/sec$

Discharge capacity of graded bund: it comprises of the pond area behind the bund

Depth of water impounded behind the bund is given by

$d = \sqrt{R.\frac{VI}{50}} = 0.57$ m

Area of first ponded water $a_1 = \frac{100 \times d}{2S} \times d = 3.30 m^2$

Area of second ponded water $a_2 = \frac{n \times d}{2} \times d = .165 m^2$

Total area of water ponded behind the bund i.e $(a_1 + a_2) = 3.46 m^2$

Calculation of Wetted perimeter:

$(P) = \{\sqrt{(100d/s)^2 + d^2}\} + \sqrt{(nd^2 + d^2)}$

P = 12.30 m

Determination of mean velocity by Manning's formula

$v = 1/n \times R^{2/3} S^{1/2}$ (m/s)

v = 0.76 m/sec

Discharge Capacity is given by

$Q = (a_1 + a_2) \times v (m^3/sec) = 2.60 m^3/sec$

Calculation of bund dimension:

Total height of the bund is given by (H) =d + 20%d + overflow of weir

H = 0.574 + 0.1148 + 0.30 = 0.99 m

Base width (B) = nd + 3d = 2.30 m

Top width = B – 2nH = 0.32 m

Calculation of earthwork due to bunding**:**

Earthwork (E_w) per hectare is given by: cross sectional area of bund x length of bund

$E_w = \left\{\frac{(B+T) \times H}{2}\right\} \times L = 452.80 m^3$

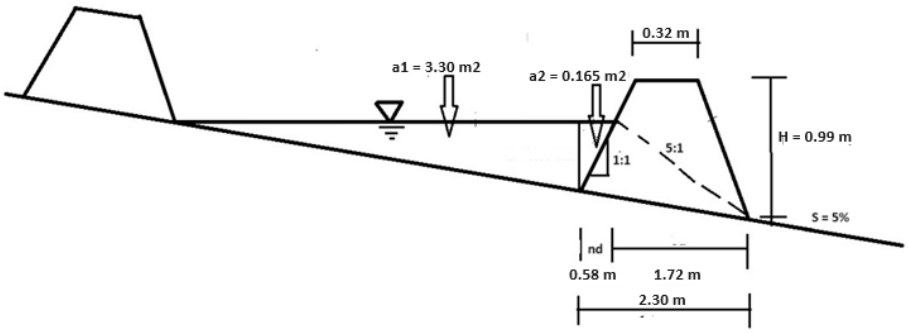

Figure 1: Dimensional detail of graded bund

Table 1: Detail of graded bund

Vertical Interval (V.I) metre	Horizontal Interval (H.I) metre	Total height of bund (H) metre	Top width (T) metre	Bottom width (B) metre	Earthwork per hectare cubic metre
1.1	22	0.99	0.32	2.30	452.80

The above design may be followed for the design dimension of graded bund. The proposed design may be used to control the soil erosion and proper utilization of runoff. The slope can be effectively used by constructing bund for storage of water in agricultural purposes. The earthwork estimation may be followed to enable the farmer to estimate the expenses related to construction of graded bund.

References

1. "Soil and water conservation Engineering " Dr R Suresh Standard Publishers Distributers
2. Beg Mohd K.A and Gupta A . 2009 Development of graphs and Nomographs for design of uniform graded bund
3. Das, D.C.1977 Design of narrow base terracing. Soil conservation digest 4 (2) Association for soil and water conservation Dehradun
4. Das, G.2002 Hydrology and soil conservation Engineering. Pub. Prentice Hall of India Pvt Ltd, New Delhi
5. Free press journal report 2023
6. Tideman, E.M 1996 Watershed Management – Guidelines for Indian condition, Omega Scientific Publishers, New Delhi