

**ROHINI COLLEGE OF ENGINEERING AND TECHNOLOGY**



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**COLLEGE OF ENGINEERING AND TECHNOLOGY**

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**DEPARTMENT OF AGRICULTURAL ENGINEERING**

**AI3402 SOIL AND WATER CONSERVATION ENGINEERING**

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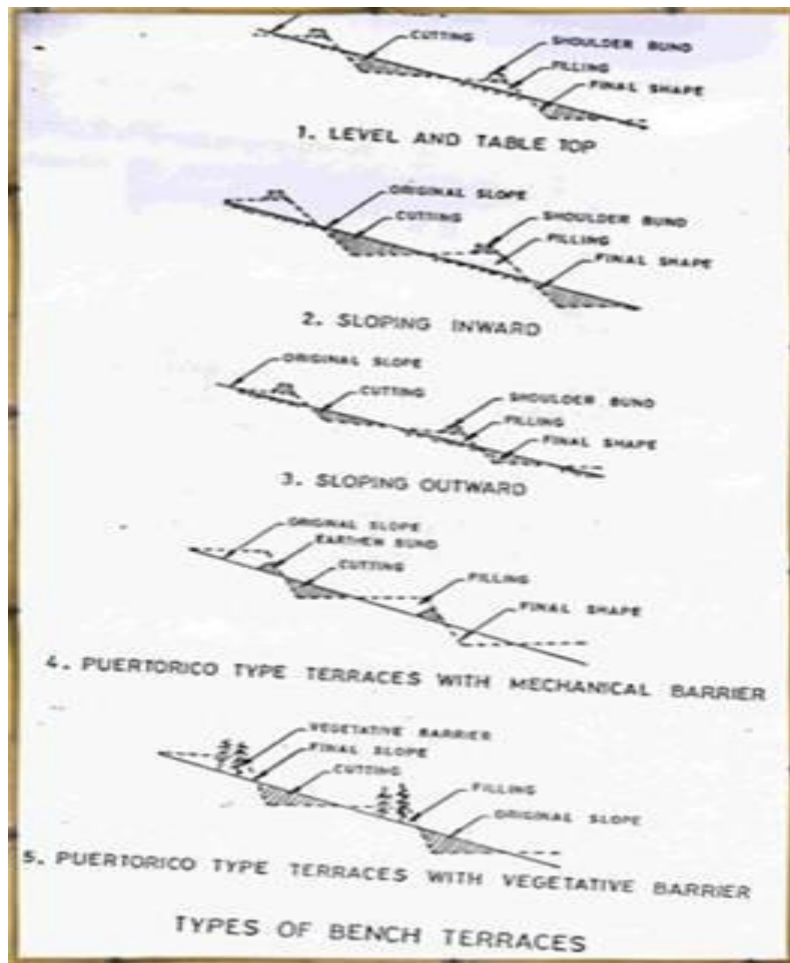
### 3.4 Bund Construction

In India, construction of bund is done by manual labour, but bullock-drawn buck scrapers, tractor plough, tractor pulled grade terraces, bulldozers and motor graders are also popular.

#### Soil and Water Conservation Technology for Hill Slopes



Contour trenches and stone walls



### Salient features

- Suitable erosion control in hills
- Adopted for hill slopes >20%
- Normal size: 1000 cm<sup>2</sup> to 2500 cm<sup>2</sup>
- Continuous or interrupted
- Stone terraces and walls are adopted whether stones are available

### Bench Terracing

1. Function : It helps to bring sloping land into different level strips to enable cultivation.
2. General information : It consists of construction of step like fields along contours by half cutting and half filling. Original slope is converted into level fields. The vertical and horizontal intervals are decided based land slope.
3. Cost : Approximate cost for laying the terrace is Rs. 8000/- per ha.
5. Salient features : The benches may be inward sloping to drain off excess water.

The outward sloping benches will help to reduce the existing steep slope to mild one.

It is adopted in soils with slopes greater than 6%.

## **Grassed waterways: Location, construction and maintenance**

### **Construction of the Waterways**

It is advantageous to construct the waterways at least one season before the bunding. It will give time for the grasses to get established in the waterways. First, unnecessary vegetation like shrubs etc. are removed from the area is marked for the waterways. The area is then ploughed if necessary and smoothed. Establishment of the grass is done either by seeding or sodding technique. Maintenance of the waterways is important for their proper operation. Removal of weeds, filling of the patches with grass and proper cutting of the grass are of the common maintenance operations that should be followed for an efficient use of waterways.

### **Selection of Suitable Grasses**

The soil and climate conditions are the primary factors in selection of vegetations to be established for construction of grassed waterways. The other factors to be considered for selection of suitable grasses are duration of establishment, volume and velocity of runoff, ease of establishment and time required to develop a good vegetative cover. Furthermore, the suitability of the vegetation for utilization as feed or hay, spreading of vegetation to the adjoining fields, cost and availability of seeds and redundancy to shallow flows in relation to the sedimentation are the important factors that should be considered for the selection of vegetation.

Generally, the rhizomatous grasses are preferred for the waterway, because they get spread very quickly and provide more protection to the channel than the brush grasses. Deep rooted legumes are seldom used for grassed waterways, because they have the tendency to loosen the soil and thus make the soil more erodible under the effect of fast flowing runoff water. Sometimes, a light seeding of small grain is also used to develop a quick cover before the grasses are fully established in the waterway.

### **Construction Procedure and Maintenance**

Ordinary tools such as slip scraper can be easily used for construction of waterways. However, the use of grader blade or a bulldozer can be preferred, particularly when a considerable earth movement is needed. Since the channel is prone to erosion before vegetations are established, it is very essential to construct the waterway when the field is in meadow and the amount of runoff from the area is also very less. In addition, if the erosion hazard is very high, then runoff should also be essentially diverted from the waterway until a good grassed cover is developed in the waterway.

The construction of grassed waterways is carried out using the following steps.

### **Step-1: Shaping (Soil Digging)**

The shaping of the waterway should be done as straight and even as possible. Any sudden fall or sharp turn must be eliminated, except in the area where the structure is planned to be installed in the waterway. In addition, the grade should also be shaped according to the designed plan. Also, the stones and stumps which are likely to interfere with the discharge rate must be removed.

### **Step-2: Grass Planting**

After shaping the waterway channel, the planting of grasses is very important. Priorities should always be given to the local species of grasses. The short forming or rhizome grasses are more preferable as compared to the tall bunch type grasses.

In large waterways, the seeding is cheaper than the sodding. Therefore, the seeding should be preferred for grass development. It is also suggested that the seeded area should be mulched especially for production purposes. Immediately after grass planting, the waterways should not be allowed for runoff flow.

### **Step 3: Ballasting**

Ballasting is done in those localities where rocks are readily available adjacent to the sites and waterway gradient is very steep. Ballasting is generally recommended for the waterways in the small farms. The stones to be used for this purpose should be at least of 15 to 20 cm diameter; and they should be placed firmly on the ground. From stability point of view, on very steep slopes, wire mesh should be used to encase the stones. In parabolic shaped waterways, partial ballasting should be done in the centre, leaving the sides with grass protection.

### **Step 4: Placing of Structure**

Structures (drop) are essential if there is sudden fall in the waterway flow path. Because under this situation, there is a possibility of soil scouring due to falling of water flow from a higher elevation to a lower elevation. For eliminating this problem, the constructed structure must be sufficiently strong to handle the designed flows successfully. As a precautionary measure, care should be taken to see that the water must not flow from the below or around the structure but through the top of the structure. In addition, the structure should be constructed on firm soils with strong and deep foundation. The apron or stilling basin of drop structures should be sufficiently strong and able to absorb or dissipate the energy/impact of falling water. After construction, earth filling should be done around the structure and it should be properly consolidated to prevent further settlement. Proper sodding should also be provided at the junction of earth filling and the structure to prevent tunneling.

## Maintenance

The grasses grown in waterway should always be kept short and flexible, so that they shingle as water flows over them, but do not lodge permanently. For this purpose, the grass should be mowed two to three times in a year. The mowed grasses must be removed from the waterway, so that they do not get accumulated at some spots in the waterway and also should not obstruct the flow. The deposition of mowed grasses in the section of the waterway reduces the flow capacity of the waterway and also diverts the direction of flowing water which can cause turbulence and thus damage of the channel. It is also possible to keep the grasses short by light pasturing, which should not be done in wet condition. When the grass is pastured, it is necessary to apply manure to discourage grazing. The waterway should not be used as a road for livestock. After the vegetative cover is established and runoff passes through them for a long time, a light application of fertilizer should be done because the flowing runoff removes the plant food from the soil of waterway.

Similarly, if waterways are to be crossed by tillage implements, they should be disengaged, plough should be lifted and disc straightened. Tillage operation should also be done following nearly the contour. The waterway and its sides should not be touched during tillage operation. It is also essential that if there is any damage of the waterway, it should be quickly repaired so that the damage may not enlarge due to rainfalls. Overall, it should always be remembered that the waterways are an integral part of watershed conservation or land treatment system. If they fail to handle the peak discharge due to lack of proper maintenance, then the prolong flow of runoff through them can develop gullies in the area. Briefly, the maintenance of waterways can be taken up using the following process.

- a) The outlets should be safe and open so as not to impede the free flow.
- b) Grassed waterways should not be used as footpaths, animal tracks, or as grazing grounds.
- c) Frequent crossing of waterways by wheeled vehicles should not be allowed.
- d) Newly established waterways should be kept under strict watch.
- e) The large waterways should be kept under protection with fencing.
- f) Waterways must be inspected frequently during first two rainy seasons, after construction.
- g) If there is any break in the channel or structures, then they should be repaired immediately.
- h) The bushes or large plants grown in the waterway should be removed immediately as they may endanger the growth of grasses.

i) The level of grass in waterway should be kept as low and uniform as possible to avoid turbulent flow.

## **Types of temporary and permanent gully control structures**

### **Introduction**

Temporary physical and structural measures such as gully reshaping, brushwood dam, protection by sandbag, loose stone barrier, gabion structures and arc-weir check-dams are used to dissipate the energy of runoff and to keep the gully stable. Check-dams are constructed across the gully bed to stop channel bed erosion. By reducing the original gradient of the gully channel, check-dams reduce the velocity and erosive power of runoff. Run-off during peak flow is conveyed safely by check-dams. The structures can be either temporary or permanent. The choice of the measures and extent of their use will depend on the amount of the runoff and the status of the gully; whether young and actively eroding or mature and stabilizing naturally. Good judgment is required in determining what measures to be used that are both economical as well as effective. Consideration should then be given to the ways of stabilizing the gully head, floor and sidewalls.

An effective sediment and erosion control plan should:

- Minimize clearing: use site fingerprinting, buffers and construction phasing.
- Prevent off-site runoff from flowing across bare soils: use perimeter dikes and diversions.
- Stabilize bare soils on the site: use erosion control mats, planting, retaining walls.
- Remove sediment from runoff before it leaves the site: use stabilized construction entrances/exits, silt fences, sediment traps, check dams.
- Plan soil disturbance activities for the dry season.