32. CUTOFF DRAINS (COD)

A cut-off drain is a graded channel constructed to intercept and divert the surface runoff from higher ground/slopes and protect downstream cultivated land or village. This safely diverts the run-off to a waterway, river, gully, pond, etc. COD are integrated with waterways and flood protection efforts, including initial stages of reforestation/re-vegetation of degraded lands.

Design: The first step is to estimate a probable maximum rate of surface run-off to design a channel or ditch which will carry this amount.

Step 1: For a given area, compute **the peak discharge rate Qpt** by multiplying the corresponding Qp (m3/sec/ha) taken from Table 1 by the catchment area (Ca). Qpt = Qp x Ca

Step 2: Compute the required flow cross sectional area (A) using the corresponding **maximum permissible velocity (V)**. A = Qpt/V

Step 3: Shape of the channel. Trapezoidal or Parabolic is recommended.

Step 4: Use Depth from Table 1/A using V and Channel gradient. Gradient: 1-10ha =0.8-1%; 10-30ha = 0.5%; 30-50ha= 0.25%

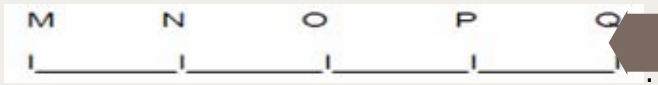
Step 5: Find the channel discharge per unit of depth using Table 1/B attached. Then find top width of the cut-off drain. For trapezoidal and parabolic cross-section: runoff from the catchment divided by Discharge from the cut-off drain (table 1/B).

Layout: Make graded contour and put pegs at an interval of 10 meters. Use this as the center of the channel to be excavated.

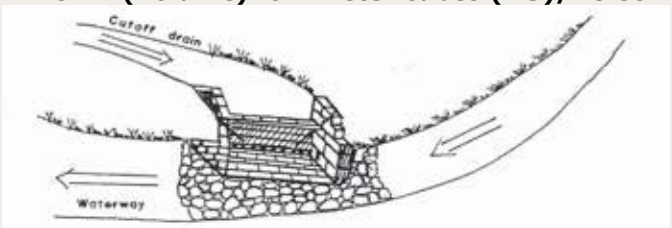
- Take additional pegs and string. **O** indicates the central peg. The other four pegs indicate the top dimension of the channel.

NO + OP = Bottom depth – and - **MNOPQ** = Top Width

- Construction starts digging out NRSP first and then shaping the channel by digging **MNR** and **PQS**



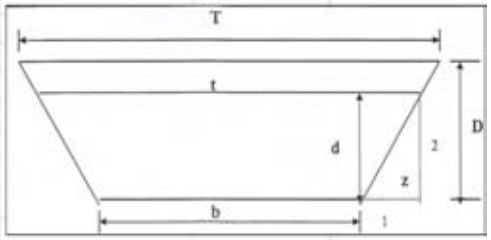
WORK NORM (Volume): 0.7 Meter cubes (M3)/Person Day



Design

Table 1. Values of Runoff Coefficient

Land Use/Cover	Runoff Coefficient		
	Slope (0-5%)	Slope (5-10%)	Slope (10-30%)
CULTIVATED LAND			
Open Sandy loam	0.25-0.30	0.4	0.52
Clay and silt loam	0.5	0.6	o.72
Tight Clay	0.6	0.7	0.82
PASTURES			
Dense cover	0.1	0.16	0.22
Medium cover	0.3	0.36	0.42
Open pastures	0.4	0.55	0.6
FOREST/WOODLAND			
Dense cover	0.1	0.25	0.3
Medium cover	0.3	0.35	0.5
Scattered	0.4	0.5	0.6



Cross Section Area (A) = $bd + Zd^2$

Wetted Perimeter (P) = $b + 2d\sqrt{Z^2+1}$

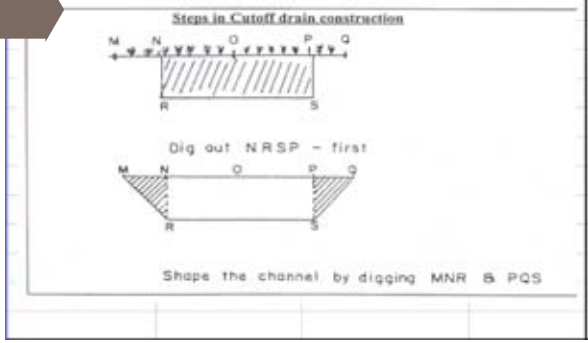
Hydraulic Radius (R) = A/P = $\frac{bd + Zd^2}{b+2d\sqrt{Z^2+1}}$

Table 2/A: Depth of a channel in meters

Channel Slope	Maximum allowable velocity (m/sec)					
% Slope	0.6	0.9	1.2	1.5	1.8	2.1
1					0.4	0.5
0.5				0.5	0.7	0.9
0.25	0.3	0.4	0.6	0.9		

Table 2/B: Dischrge in m3/sec/meter width

Depth of Channe	Slope (%)		
	0.8-1	0.5	0.25
0.3	0.6	0.4	0.25
0.4	0.9	0.65	0.45
0.5	1.3	0.95	0.65
0.6	1.8	1.3	0.95
0.7	2.25	1.7	1.2
0.8	2.8	2.15	1.5
0.9	3.4	2.65	1.8



Example: Find the size of a channel (cut-off drain) to be constructed at the foot on an hilly grassland with 20% slope. Soils of the catchment are clay. The runoff area is 6 ha. The grassland has medium cover.

Step 1: Find the corresponding run-off using rational method (table 1):

Q = K IA/36, where Q = the peak run-off rate (m3/sec); K = the run-off coefficient; I = the rainfall intensity (cm/hour); A = the runoff producing area.

Thus, K= 0.82, I = 15cm/hr, A= 6 ha, then Q= 0.82 x 15 x 6 ha/36 = 2.05m3/sec.

Step 2: Find the maximum allowable velocity using table 2/A above. In this case, Velocity = 1.8 m/sec for clay surface.

Step 3: Determine the gradient and depth of channel. For a catchment of 6 ha, a 1% slope selected. Following this determine channel depth from table 2/A against 1.8 velocity and 1% slope, which is = 0.4 m.

Step 4: Find channel discharge rate per unit width from Table 2/B. Accordingly, for gradient of 1% and depth 0.4, the discharge is 0.9m3/sec.

Find the top width of the cutoff drain by dividing the catchment run-off by the channel discharge rate per unit width = 1.6/0.9 = **1.8 m**

Limitations & environmental risks:

. Basic water engineering skills required
. Regular maintenance needed
. Medium/high envir. risks (can generate gullies if poorly designed or maintained)