

Design Criteria for Cross-Slope Channels

R. P. Beasley, Department of Agricultural Engineering
College of Agriculture

Description

Cross-slope channels are wide, shallow channels constructed across the slope to provide drainage and erosion control on nearly flat to gently sloping upland. They may be used on land with uniform slopes, irregular slopes or a combination of the two. (See Figures 1, 2, 3 and 4). Farming operations are normally up and down the slope to provide maximum drainage between channels. In plowing with a moldboard or disk plow, raise the plow when crossing the channel and ridge. Plow the channel and ridge lengthwise, if required, to maintain the desired cross section.

The channel may be constructed with a V-shape or a trapezoidal shape as shown in Figure 5. If the channel is to

be crossed in farming operations, side slopes of 10 to 1 or flatter on V-shaped channels and 8 to 1 flatter on trapezoidal channels are desirable. If the channel is not to be crossed, steeper side slopes may be used. In constructing the channel excavated earth may be used to fill depressions between channels, to build a ridge on the downstream side of the channel, or both.

Consider the use of cross-slope channels on land less than 1.5 percent slope that has both a drainage and erosion problem. On very erodible soils, consider the use of terraces on land over 1.0 percent slope.

Spacing

Measure the space between channels at the widest point and in most cases in the direction of the crop rows. The spacing should not exceed:

1320 feet for land slopes up to 0.3 percent

660 feet for land slopes from 0.3 to 0.6 percent

440 feet for land slopes from 0.7 to 1.0 percent

*330 feet for land slopes from 1.1 to 1.5 percent

*On very erodible soils, over 1.0 percent slope, the spacing used between terraces may be more desirable. See UMC Guide 1504 "Design Criteria for Terraces".

Locate cross-slope channels to give adequate drainage. This may result in a closer spacing than indicated above.

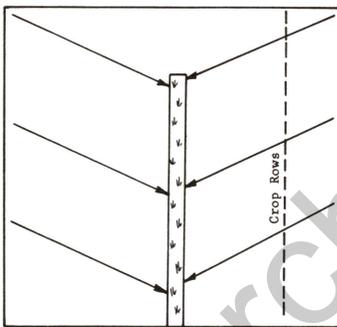


Figure 1. Cross-slope channels on uniform, gently sloping land.

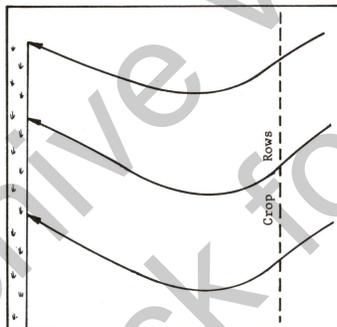


Figure 2. Cross-slope channels on irregular, sloping land.

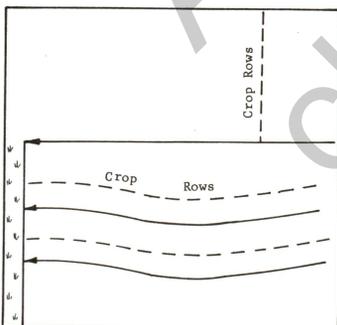


Figure 3. Cross-slope channel to intercept runoff and provide drainage for flat land. Terraces to control erosion on steeper land below.

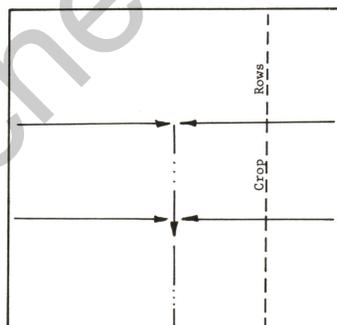


Figure 4. Using a drainage ditch as an outlet for cross-slope channels on flat slopes. The drainage ditch is made deep enough to provide necessary grade in the cross-slope channels.

Grade

Minimum Grade. The minimum grade normally should be at least 0.2 percent; however, a grade less than this may be needed in some cases. When the channel grade is less than 0.3 percent one of the following practices may be needed to improve drainage in the channel: (1) smooth out the bottom of the channel with a drag, cultivator or grader, following planting and cultivation, if the crop rows are planted across the channel, (2) plant crop rows that fall in the channel parallel to the channel to improve drainage, or (3) do not cultivate or plant crops in the channel. Also careful construction and maintenance will be necessary to prevent wet spots from developing. A V-shaped channel will tend to reduce channel wetness and is desirable where grades approaching the minimum are used.

Maximum Grade. As the number of acres drained into a channel on a given grade is increased the depth of flow and the velocity will be increased. The velocity should not exceed 2.0 feet per second in cultivated channels or 3.5 feet

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per second in channels with a good growth of annual grasses. Those channels above the line denoted by the * in Tables 1 and 2 will have velocities less than 2 feet per second. Those channels below the line will have velocities varying from 2 to 3.5 feet per second.

Depth

The channels should be deep enough to provide drainage for crop rows. The bottom of the channel should be at least 0.3 feet below the bottom of the furrow between rows or 0.6 feet below the adjacent field surface.

The depth of flow that can be expected in the channels with either a row crop or a good growth of annual grasses is given in Tables 1 and 2. These tables give the capacity of

TABLE 1
DEPTH OF FLOW (FEET) IN V-SHAPED CROSS-SLOPE CHANNELS WITH 10 TO 1 SIDE SLOPES

Drainage Area, Acres Land Slope, Percent			Channel Grade, Percent						
0-0.4	0.5-0.9	1.0-1.5	0.2	0.3	0.4	0.5	0.6	0.8	1.0
4	3	2	1.0	0.9	0.8	0.8	0.7	0.7	0.6
10	7	5	1.2	1.1	1.0	0.9	0.9	0.8	0.8
20	15	10	1.4	1.3	1.2	1.1	1.0	1.0	0.9
30	22	15	1.6	1.4	1.3	1.2	1.1	1.1	1.0
40	30	20	1.7	1.5	1.4	1.3	1.2	1.2	1.1
50	37	25	1.8	1.6	1.5	1.4	1.3	1.3	
60	45	30	1.9	1.7	1.6	1.5	1.4	1.3	
70	52	35	*1.9	1.8	1.7	1.6	1.5		
80	60	40	2.0	1.8	1.7	1.7	1.6		
90	67	45	2.1	1.9	1.8	1.7			
	75	50	2.1	2.0	1.8	1.8			
	82	55	2.2	2.0	1.9				
	90	60	2.3	2.1	2.0				

*Channels above this line may be cultivated. Channels below this line should not be cultivated. Some grass cover will be required to prevent erosion in the deeper channels. This grass should be mowed frequently so that the flow of water will not be restricted.

TABLE 2
DEPTH OF FLOW (FEET) IN CROSS-SLOPE CHANNELS WITH AN 8-FOOT BOTTOM AND 8 TO 1 SIDE SLOPES

Drainage Area, Acres Land Slope, Percent			Channel Grade, Percent						
0-0.4	0.5-0.9	1.0-1.5	0.2	0.3	0.4	0.5	0.6	0.8	1.0
4	3	2	0.9	0.7	0.7	0.6	0.6	0.6	0.5
10	7	5	1.0	0.9	0.8	0.8	0.7	0.7	0.6
20	15	10	1.2	1.1	1.0	1.0	0.9	0.8	0.8
30	22	15	1.4	1.2	1.1	1.1	1.0	0.9	0.9
40	30	20	1.5	1.4	1.3	1.2	1.1	1.0	1.0
50	37	25	1.6	1.5	1.4	1.3	1.2	1.1	
60	45	30	*1.7	1.5	1.4	1.4	1.3		
70	52	35	1.8	1.6	1.5	1.4	1.3		
80	60	40	1.9	1.7	1.6	1.5			
90	67	45	1.9	1.8	1.6	1.5			
	75	50	2.0	1.8	1.7				
	82	55	2.0	1.9	1.8				
	90	60	2.1	1.9					

*Channels above this line may be cultivated. Channels below this line should not be cultivated. Some grass cover will be required to prevent erosion in the deeper channels. This grass should be mowed frequently so that the flow of water will not be restricted.

channels when the flow is confined within a channel with the indicated depth and side slopes. The capacity of the channel is increased if the ridge is constructed high enough to cause water to flow over the ground surface above the channel. The extent of the increase will depend on the height of the ridge and the slope of the land.

The height of the channel should be adequate to contain the depth of flow. The height, "h" in Figure 5, is measured from a point 1 1/2 feet from the peak of the ridge to a point 1 1/2 feet from the center of a V-shaped channel or to the bottom of a trapezoidal channel.

A channel height greater than the depth of flow given in Tables 1 and 2 may be necessary to provide drainage for crop rows or adequate grade in the channel.

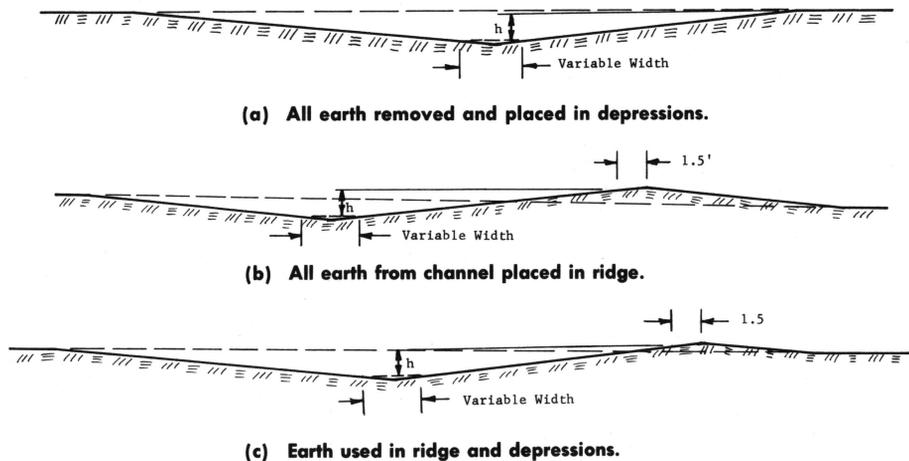


Figure 5. Typical cross-slope channel cross sections.