4.2 CANAL ALIGNMENT

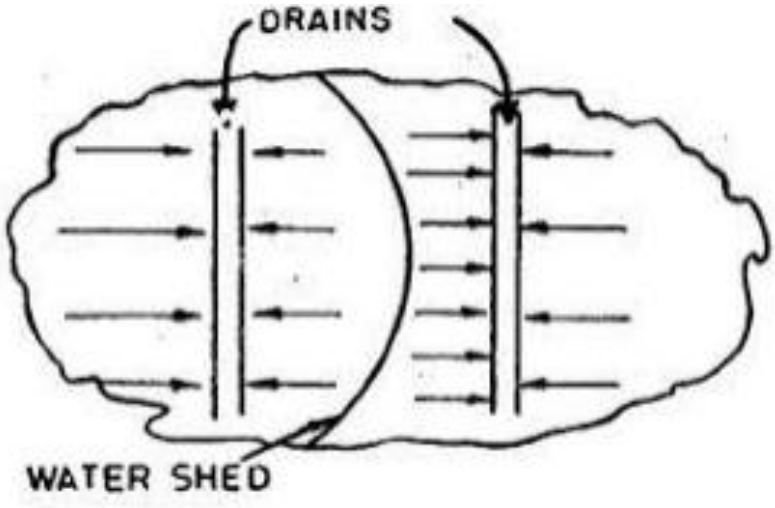
A canal has to be aligned in such a way that it covers the entire area proposed to be irrigated, with shortest possible length and at the same time its cost including cost of drainage works is minimum. A shorter length of canal ensures less loss of head due to friction and smaller loss of discharge due to seepage and evaporation, so that additional area may be brought under cultivation. A canal may be aligned as a contour canal, a side slope canal or a ridge canal according to the type of terrain and culturable area.

Irrigation canals can be aligned in any of the three ways:

(i) Watershed Canal
(ii) Contour Canal
(iii) Side slope Canal

i) Watershed Canal

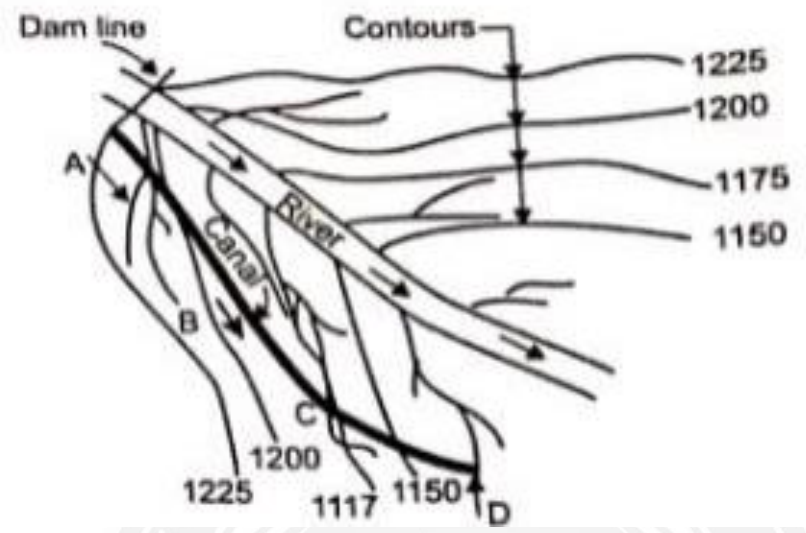
The dividing line between the catchment area of two drains or streams is called watershed. Thus between two major streams, there is the main watershed which divides the drainage areas of the two. Similarly , between any tributary and the main stream and also between any two tributaries there are subsidiary watersheds, dividing the drainage between the two streams on either side. For canal system in plain areas, it is often necessary as well as advantageous to align all channels on the watersheds of the areas, they are designed to irrigate. The canal which is aligned along any natural watershed, is called a watershed canal. In such a canal, water flows by gravity, either side of the canal, directly or through small irrigation channels. Moreover, cross drainage works avoided as the natural drainage will never cross a watershed, because all the drainage flows away from the watershed. Sometimes watershed may have to abandoned in order to bypass localities settled on the watershed.



(Alignment of a watershed canal aligned along the watershed)

ii)Contour Canal

The above arrangement of providing the watershed is not possible in hilly areas. In the hills, the river flows in the valley, while the watershed or the ridge line may be hundreds of meters above it. It becomes uneconomical to take the canal on top of such ridge. The canal in such cases, is generally aligned parallel to the contours of the area except that the longitudinal slopes required to generate sufficient flow velocity , are given to it. The maximum designed slope that can be provided in the canal without generating excessive velocity, is generally less the available country slope. The difference is accommodated by providing canal falls at suitable places. A contour channel irrigates only on one side because the areas on the other side is higher. As the drainage flow is at right angle to the ground contours, such a channel would definitely have to cross drainage lines. Suitable cross drainage works are then provided



iii)Side slope Canal

A side slope channel is that which is aligned at right angles to the contours. i.e. along the side slopes. Such a channel is parallel to the natural drainage flow and hence, doesn't intercept cross drainage and no cross drainage works are required.

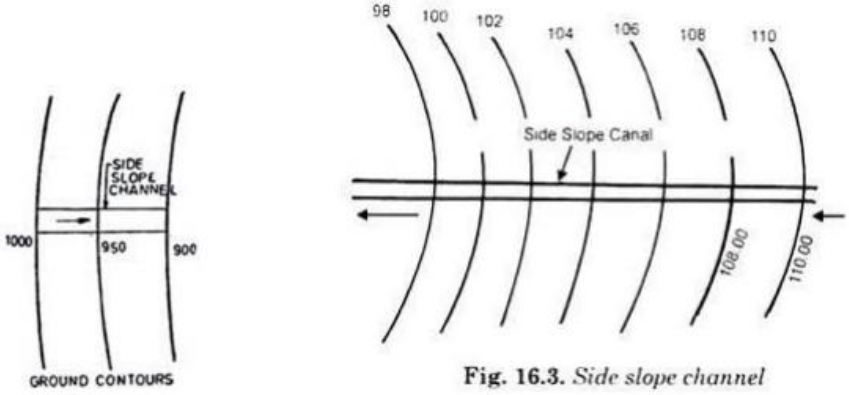


Fig. 16.3. *Side slope channel*

4.2.1 PRECAUTIONS IN CANAL ALIGNMENT

While aligning a canal following points should be considered in general:

i. The canal should be aligned on the ridge or in such a way as to obtain maximum command.

ii. So far as possible the canal alignment should be kept in the centre of the commanded area.

iii. The canal should be aligned in such a way that the length is minimum possible.

iv. The alignment should avoid inhabited places, roads, railways, properties, places of worship etc.

v. Canal should be taken through the area where subsoil formation is favourable. Water logged, alkali, saline, rocky soils create troubles.

vi. The alignment should be straight so far as possible. Where alignment is not straight simple circular curves of large radius should be provided.

vii. To ensure economy the alignment of the canal should be such that excessive cuttings and fillings are not required. The alignment should not cross hills or depressions.

4.2.2 DESIGN OF OPEN CHANNEL

• Open Channel is a passage through which water flows and has upper surface exposed to atmosphere.

• Open channel design involves determining cross-section dimensions of the channel for the amount of water the channel must carry (i.e., capacity) at a given flow velocity, slope and, shape or alternatively determining the discharge capacity for the given cross-section dimensions.

i) Area of Cross Section (a):

Area of cross section of for a rectangular cross section, of wetted section. For a rectangular cross section, if b = width of channel and y = depth of water,

the area of wetted section of channel (a) =bxy.

ii) Wetted Perimeter (p):

It is the sum of the lengths of that part of the channel sides and bottom which are in contact with water.

The wetted perimeter (p) = b+2y.

iii) Hydraulic Radius (R):

It is the ration of area of wetted cross section to wetted perimeter. The hydraulic radius

$$(R) = \frac{a}{p} = \frac{by}{b+2y}$$

iv) Hydraulic Slope (S):

It is the ratio of vertical drop in longitudinal channel section (h) to the channel length (l). Hydraulic Slope

$$(S) = \frac{h}{l}$$

v) Freeboard:

• It is the vertical distance between the highest water level anticipated in channel flow and the top of the retaining banks.

• This is provided to prevent over topping of channel embankments or damage due to trampling. This is provided between 15.25% of normal depth of flow.

vi)Discharge Capacity of Channel

Channel capacity can be estimated by equation given as:

$$Q = \frac{(16667)(DDIR)(A)}{(HPD)(Ei)}$$

where,

Q = channel capacity (L/min)

DDIR = design daily irrigation requirement (mm/day)

A = irrigated area supplied by canal or ditch (ha)

HPD = hours per day that water is delivered

Ei= irrigation efficiency including conveyance efficiency of canal or ditch (percent).

• The velocity of flow in a canal or ditch should be non-erosive and non-silting that prevent the deposition of suspended substances.

• Normally flow velocity in excess of 0.6 m/s is non silting (Schwab et al., 1993).

• The maximum velocity that does not cause excessive erosion depends on the erodibility of the soil or lining material.

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