

# LECTURE NOTES – VI

## « HYDROELECTRIC POWER PLANTS »

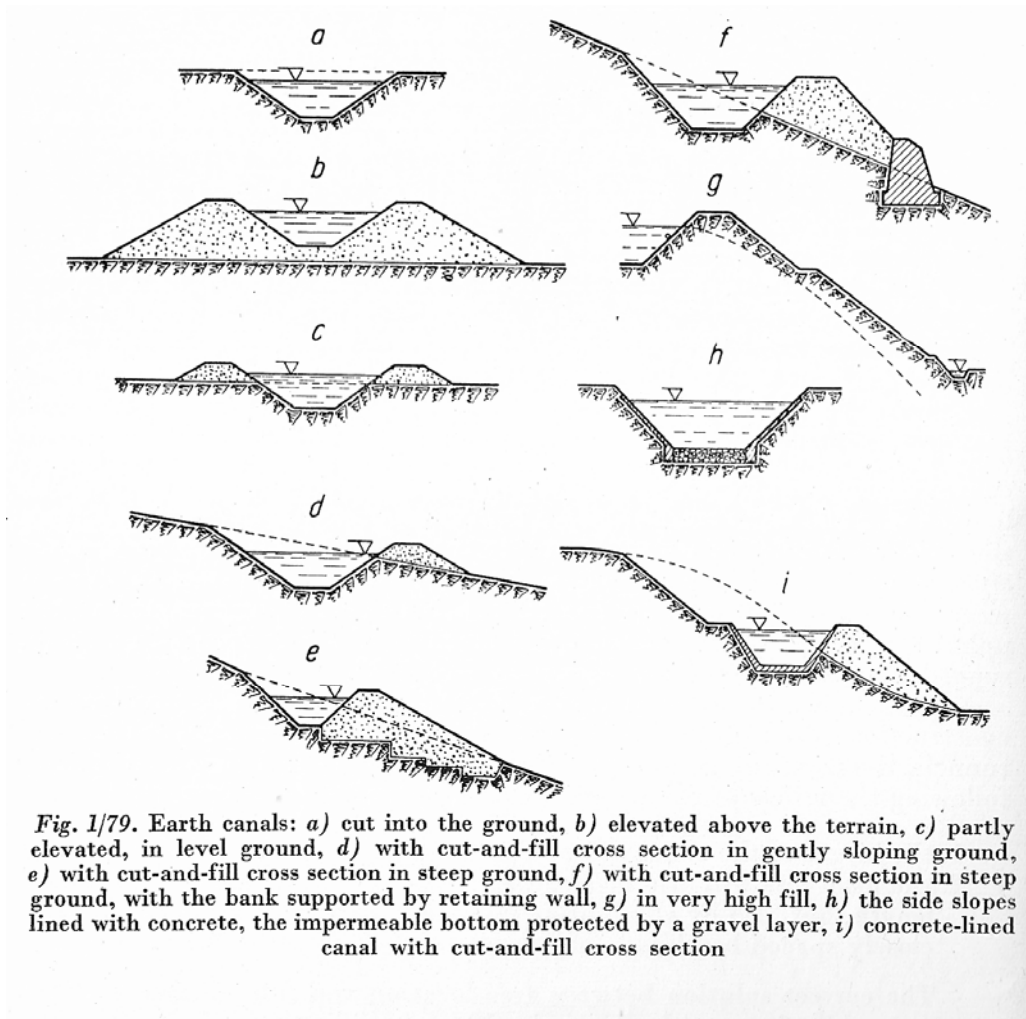
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## Chapter 6

### The Power Canal

On gentle hill slopes, but especially on steep mountain sides, the canal should closely follow the contour lines of the area. Over sufficiently uniform area, the power canal may be designed with an open cross-section through cuts, overfills and in cut-and-fills as shown in the Figure.



On mountainous slopes it may not be possible to follow the irregular contour lines: deep valleys are to be bridged by *aqueducts* (such as elevated canals or canal bridges), and high hills crossed by water conveying tunnels. Cross-sections of canals located on steep, hilly mountain slopes are shown in the Figure.

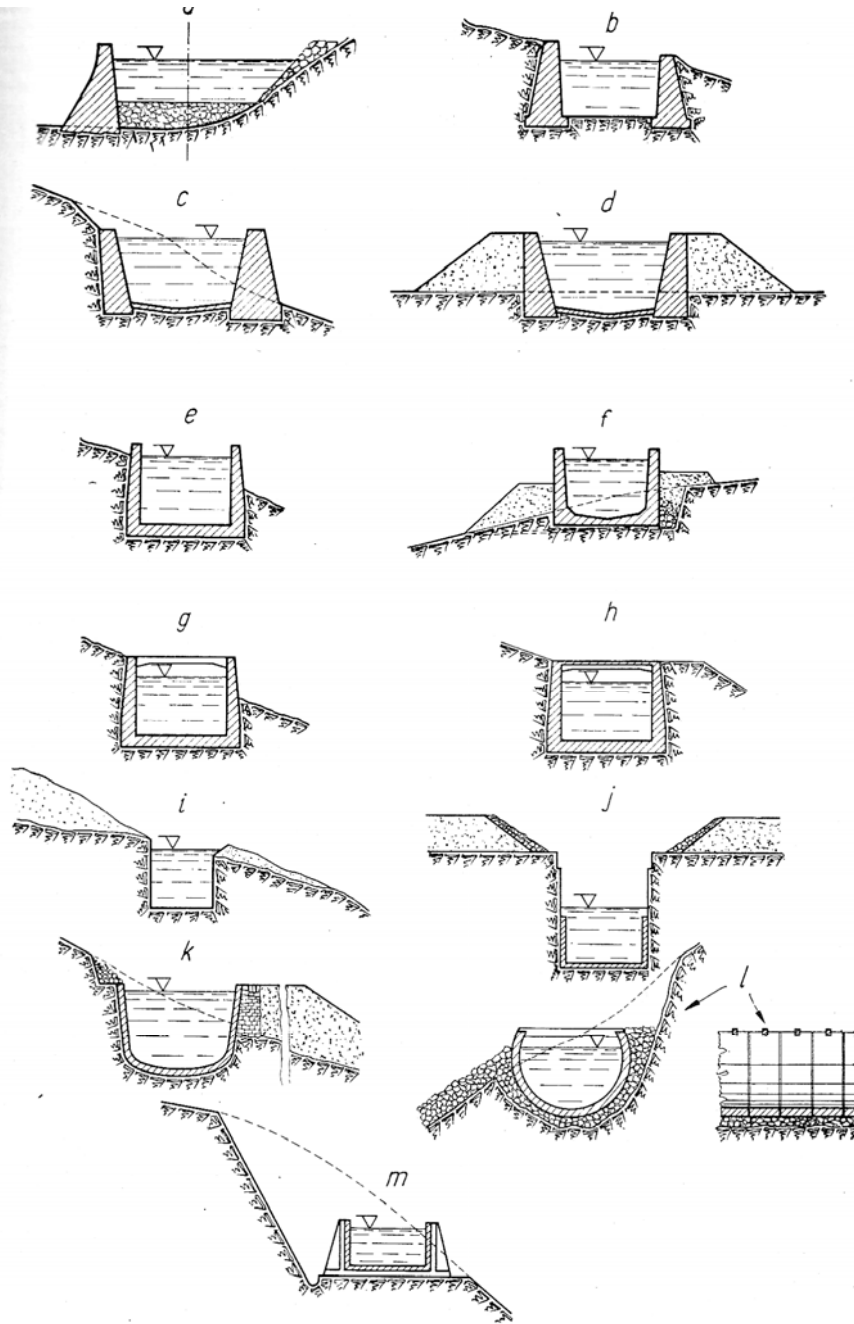


Fig. 2/79. Concrete flumes and canals over rocky hillsides: a) canal with downhill retaining wall, b) canal with retaining walls at both sides, c) canal with retaining walls at both sides, and with lined bottom, d) canal with retaining walls at both sides, supported by embankments, and with lined bottom, e) open reinforced-concrete flume recessed into the ground, f) open reinforced-concrete flume supported by embankments, g) braced reinforced-concrete flume recessed into the ground, h) covered reinforced-concrete flume recessed into the ground, i) unlined canal cut in rock, j) partly lined canal cut in rock, k) canal with cut-and-fill cross section, supporting embankment, cut in rock, l) reinforced-concrete flume in trench excavated in rock, m) reinforced-concrete flume set on bench cut in rock

Although a canal located according to these principles involves the construction of relatively more expensive structures, such as bridges and tunnels, the resulting route may still be more economical than that strictly following the contour lines than that strictly following the contour lines of the hilly area, because;

1. The length of the canal will be significantly reduced,
2. The head loss will also be smaller.

It should be kept in mind that geological conditions of the area decisively influence the location of the canal. In order to establish reliable bases for following the alignment and determining the cross-sections, the geologic formations, the dip of layers, the quality of rock should be explored very thoroughly over sections in cut and fill. The proper solution will be governed by,

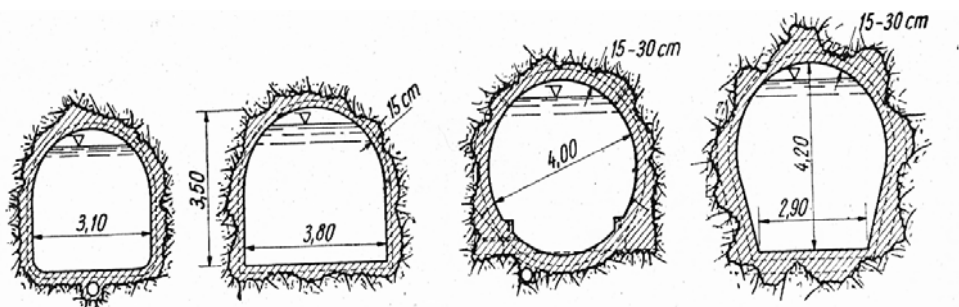
- a) The permissible slope of banks and embankments,
- b) The depth of the cut, respectively the height of the fill,
- c) The dimensions and foundations of canal walls, backfills if required,
- d) The extent and quality of lining.

The construction of open power canals may meet difficulties if,

- 1) The mountain slope is not stable,
- 2) The mountain slope is too steep,
- 3) The mountain slope above the canal is likely to produce much rubble,
- 4) Snow avalanches are to be expected,
- 5) During extremely severe and long winter periods the water freezes in the canal.

With the above conditions (occurring separately or simultaneously), the following solutions can be applied in the critical sections;

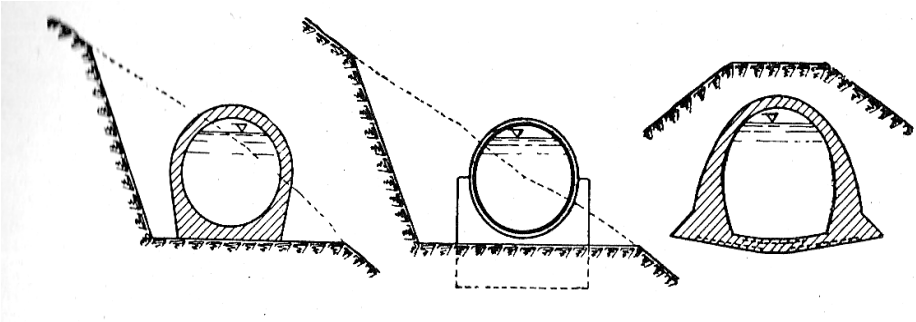
- A) Types of open or closed canals may be constructed of concrete or reinforced concrete,
- B) The water may be conveyed in tunnels. In order to reduce head losses, such tunnels should be designed for free surface flow conditions.



**Figure.** Free-flow tunnels

Thickness and quality of lining in free flow tunnels are governed by *rock pressure, hydraulic requirements of water conveyance and water tightness* and sometimes by the aggressivity of the waters conveyed. Internal water pressures generally need not be considered.

Adequate protection against snow avalanches and freezing can be provided by a closed canal located on the area or even by a simple cover over a canal.



**Figure.** Closed and covered power conduits