

**Subject :— CUT-OFF TRENCH FOR EARTH DAMS**

G. C. No.  
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The primary function of a cut-off trench in an earth dam is to provide an effective barrier against seepage of water through the base or foundation of the structure. Many a time the field engineers need guidance regarding the depth up to which the cut-off trench should extend into the relatively impervious stratum. The thumb-rule of extending the cut-off trench up to 1.5 metres or so in good rock is quite arbitrary and involves too many uncertainties besides involving avoidable costs. This circular is intended to provide the necessary guide lines to the field engineer with a view to equip him with a more rational and scientific approach to the problem.

2.0. The earth-crust comprises of several rock types each having a wide range of characteristics which may make one dam site articles different from the other. It is not necessary to find the cut-off trench in good rock at any cost or at high cost as unlike in case of foundations for masonry and concrete dams, the bearing power of the stratum on which the cut-off trench of earth dam is founded is of relatively less significance. The cut-off trench for an earth dam is not to be misunderstood as foundations of an earth dam.

2.1. Before attempting to excavate the cut-off trench, it is necessary that the field engineers should have the preliminary idea about the geological formations that are likely to be encountered at a given site. A systematic programme of sub surface investigations should be drawn out and worked upon in order to have a comprehensive knowledge about the geology of the site. In this connection, attention of the field officers is drawn to Chief Engineer's Circular on "Geological Investigations for dam sites" issued *vide* Government of Gujarat, P. W. D., No. MIP-2270/276(76) K, dated 5th February, 1971.

2.2. On the basis of the study of the report on Geology of the site, either one or more of the following alternatives may be found feasible :—

(a) To provide a positive cut-off trench extending fairly deep into relatively impervious stratum or rock formations with or without the necessity of providing a grout curtain below the bed of the cut-off trench.

(b) To provide a partial cut-off trench resting on pervious stratum with or without curtain.

2.3. If the cut-off trench is terminated in rock formation the necessity of grouting below the bed of the cut off trench will arise if the rock on exposure is found to be weathered and has cracks, joints and crevices. Similarly, the necessity of grouting below the bed in case of partial cut-off trench will be governed by the cost and effectiveness of the grout curtain *vis-a-vis* the value of water loss through seepage below and beyond the partial cut-off-trench. In certain cases where it is desirable to prevent excessive loss of water through fairly deep pervious stratum, it might be prudent and economical to provide only a partial grout curtain. For details regarding grouting, the attention of the field officers is drawn to the following two publications.

(a) I. S. 4999-1968, on "Recommendations for grouting of Pervious Soils", and

(b) Finalised Draft I. S. Doc-Bdc-52 (1828) on Grouting of Rock foundations in River Vally Projects.

2.4. With the passage of time, good and relatively simple sites for building earth dams are getting exhausted and in times to come, more unconventional and difficult sites will be encountered. The field officers would thus be called upon to fix up among other things depth of C. O. T. without sacrificing the overall economy.

3.0. In the above context, the choice of the particular type of the cut-off trench with or without grouting should be judiciously made by the field officers. The following norms may be adopted as broad guide lines to make such a choice, though they are not to be strictly adhered to in each individual case.

3.1. For dams exceeding 30 metres height, curtain grouting below the bed of cut-off trench should be carried out if water loss exceeds one lugeon.

3.2. For dams under 30 metres height, curtain grouting below the bed of cut-off trench should be carried out if water loss exceeds 3 lugeons.

3.3. In both the above cases, the grouting at the abutment contacts of the cut-off trench should extend about 50 to 100 ft. beyond the ends of the impervious core so as to avoid seepage losses by out-flanking.

3.4 The cut-off trench in the abutments on either side should generally extend upto such length where C. O. T. bed level is practically the same as the top of impervious core.

3.5 The minimum bottom width of the cut-off trench for rolled filled construction should be 12 ft. so as to facilitate proper compaction by the rolling equipment. In special circumstances, width of cut-off trench at bottom may be increased to 25 to 30 percent of maximum head of water.

3.6 The side slopes of the cut-off trench depend of the nature and condition ( wet or dry ) of the material in which the trench is excavated. For a rolled back fill, they should not be steeper than 3/4:1 in order to facilitate proper compaction of the back fill in contact with the side slopes. For cut-offs excavated in rocks the side slopes may be steeper than 3/4:1, but special precautions and care should be taken during compaction for achieving good contact between the rock surface and the back fill. Overhanging and protruding rock should be removed to facilitate rolling and to secure good compaction near contacts.

3.7 The depth of the partial cut-off trench in deep pervious alluvium will be governed by (a) the economical length of the upstream impervious blanket, (b) the requirements for the exits gradient to be safe at the downstream toe and (c) other provisions of under seepage control such as relief wells, downstream filters, vertical sand drains etc.

3.8 The depth of positive cut-off trench should be limited to the stratum of relatively impervious formation either of fairly deep clay, or of soft or hard fresh rock. The water absorption of one lugeon is found to correspond to the permeability of 3 metres per year. Therefore in view of Para (3.1) and (3.2) above, the necessity of curtain grout below the bed of cut-off trench will arise only if the permeability of the stratum on which the cut-off trench is found exceeds 3 metres per year in case of dams exceeding 30 metres height, and if it exceeds 9 metres per year in case of dams under 30 metres height.

3.9 The cut-off trench may be located upstream of the axis with its centre line near the upstream one-third point of the base of the impervious core. In cases where inclined-impervious core is adopted in the embankment section, upstream cut-off is a must. In regions prone to seismic activity, the central position of the cut-off trench is more favourable. In any case the top width of the impervious back fills of the cut should be fully accommodated within the bottom width of the impervious core of the embankment section and in addition position of C. O. T. vis-a-vis, impervious core should be so fixed as to provide adequate seepage of water.

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*NOTE*.—Para 3.9 is slightly modified in Central Designs.