IS 14815 (2000): Design Flood for River Diversion Works - Guidelines [WRD 22: River Training and Diversion Works]

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Indian Standard

DESIGN FLOOD FOR RIVER DIVERSION WORKS — GUIDELINES

ICS 93.160

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

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Price Group 2

Dams (Overflow and Non-Overflow) and Diversion Works Sectional Committee, WRD 9

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Dams (Overflow and Non-Overflow) and Diversion Works Sectional Committee had been approved by the Water Resource Division Council.

Prior to the commencement of actual construction of any work in the bed of a river, it becomes obligatory, in practically all the cases, to exclude temporarily the river flow from the proposed work area during the construction period so as to permit the work to be done in dry or semi-dry condition. An efficient scheme of diverting the river flow away from the work area should aim at limiting the seepage into the work area to a minimum. Proper planning and design of such temporary diversion work would be greatly influenced by the design flood for such work in addition to other factors. This standard gives the guidelines for estimation of design flood for diversion works.

There is no ISO standard on the subject. This standard has been prepared based on indigenous manufacturers' data/practices prevalent in the field in India.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated expressing the result of a test or analysis, should be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

DESIGN FLOOD FOR RIVER DIVERSION WORKS — GUIDELINES

1 SCOPE

This standard lays down the guidelines for computation of design flood for temporary diversion of river during construction.

2 FACTORS AFFECTING THE SELECTION OF FLOOD

Usually, in the design of any diversion work it is not economically feasible to plan on diverting the largest flood that has ever occurred or may be expected to occur at the site and consequently some lesser requirement should be decided upon. This would obviously depend upon the risk involved in the diversion scheme under consideration. In the case of an earthfill dam, where considerable areas of the foundation and the structure are exposed or where overtopping of the embankment, while under construction, may result in serious damage or loss of the partially completed work, the importance of eliminating the risk of flooding is relatively great. This consideration is not as important in the case of a concrete dam since the flood waters may, if the location of appurtenant structures permits, overtop the dam with little or no adverse effect.

The following should be considered while deciding the diversion flood capacity:

a) The period of stoppage of works during flood seasons and the number of flood seasons which are to be managed during the work;
b) The cost of possible damage to completed work or work still under construction, if it is flooded;
c) The cost of delay in completion of the work; and
d) The safety of workmen and downstream inhabitants in case of sudden failure of diversion works.

3 OPTIMIZATION TECHNIQUE TO DECIDE DIVERSION FLOW CAPACITY

Designing the discharge capacity of the diversion works may be thought of in terms of an optimization calculation taking safety into account. Optimization aims at minimizing:

a) the construction cost of the diversion works, and
b) the cost of damage that would result from under-design not only at the construction site itself but also for property downstream in the event of sudden failure.

The study is based on the frequency distribution of flood peaks (annual, or for specific months of the year) or flood volumes, construction cost of diversion works and cost of damages in case of failure as illustrated in the top portion of Fig. 1. Peak flow is plotted along the abscissa and its probability of occurrence (or return period) is along the ordinate. It is convenient to keep the same abscissa for the hydro-economic analysis in the lower part of the figure.

The cost of diversion works designed to control different peak floods are expressed as annual costs for plotting the construction cost curve. The costs from all damages that will arise from inadequacy of the capacity of diversion works of different sizes should be estimated, multiplied by the probability of such an event occurring in any year and plotted against the relevant flood discharge to draw the annualized damage cost curve.

Construction costs and damage costs are added to give the total cost curve. The lowest point of the total cost curve represents the optimum economic capacity of the diversion works capable of meeting the specified performance.

This process is the basis for estimating the dimensions of the diversion works, but, of course, costing the risk to human life and other types of damages is very difficult. It is also difficult to make any realistic estimate of the flood peak liable to cause this damage. Nevertheless, it should be possible to determine the upper and lower limits of these curves with an acceptable degree of accuracy. The confidence band has been drawn in Fig. 1 on the flood frequency line at the top and on the construction cost, damage cost and total cost curves at the bottom.

Despite the uncertainties in hydrology and in costing these items, there is no significant difference in the optimum capacities read from the lowest point of the mean curve and the top and bottom limit curves.

After the above analysis, the increase in the cost of protection works to handle progressively larger floods may be compared with the cost of damages resulting if such flood occurred. Judgment may be made in determining the amount of risk that can be taken.

For small dams to be constructed in a single season, it would be sufficiently conservative to provide for the largest flood likely to occur in a 5 year period.

4 DESIGN FLOODS FOR DIVERSION CAPACITY FOR DIFFERENT TYPES OF DAMS AND BARRAGES

The diversion design flood should be arrived at according to criteria of risk and damage discussed in **2** and 3. However, the guidelines given in **4.1** and **4.2** would be useful to arrive at the capacity of diversion flood for different types of dams and barrages.

4.1 Diversion Capacity for Concrete Dams and Barrages

The capacity of the diversion flood for concrete dams and barrages may be less because flood higher than the designed one could be passed safely over the partly constructed dam. The following criteria would help in deciding the capacity :

a) Maximum non-monsoon flow observed at the dam site.

OR

b) 25 years return period flow, calculated on the basis of non-monsoon yearly peaks.

The higher of the two should be taken as the capacity of the design flood for diversion.

4.2 Diversion Capacity for Embankment Dams

Overtopping of a partly completed embankment dam would be very serious and even disastrous.

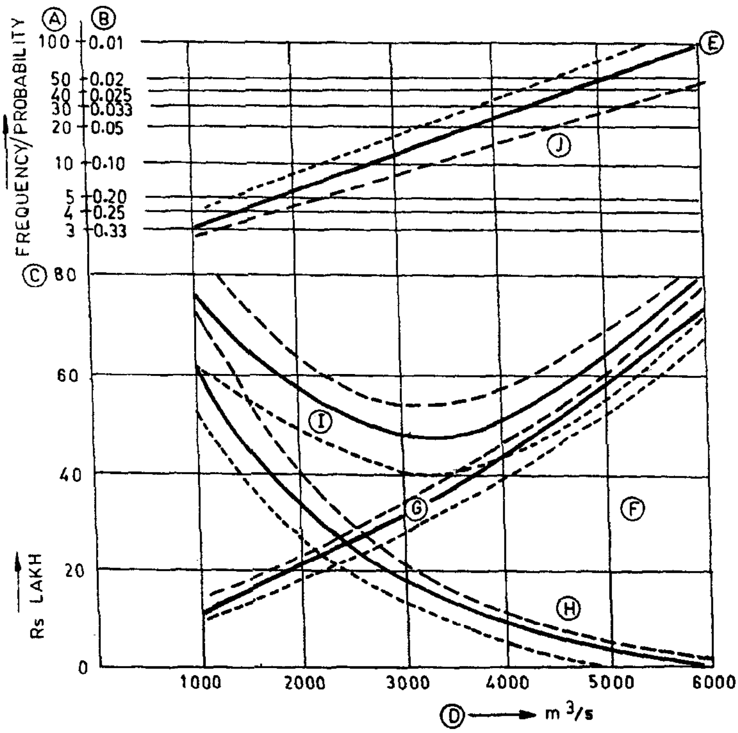
4.2.1 *For Small and Intermediate Dams*

Usually a frequency of 5 to 20 years flood is taken to decide the capacity of diversion works. In case the diversion arrangements like tunnels are to be used subsequently as permanent structure like tunnel spillway, the capacity may be equal to the discharging capacity of the permanent structure.

4.2.2 *For Large Dams*

The diversion capacity should be evaluated on the basis of risk and cost factors as outlined in **2** and **3**. However, for large dams, it is desirable that 100 years flood should be adopted for diversion works.

Suitable protection measure should be taken at the end of the construction season for the top and downstream of the embankment dam to pass surplus flow considering the possibility of the flood exceeding the design diversion flood.



A — Recurrence Interval (Years)

B — Annual Probability of Exceedence

C — Annual Costs (Lakhs of Rupees)

D — Diversion Capacity (m³/s)

E — Flood Peak (m³/s)

F — Discharge Cost Curves

G — Construction Cost Curves

H — Damage Cost Curves Based on Estimated Damage If Capacity is Exceeded

I — Total Cost Curves

J — Frequency Distribution of Flood Peaks

NOTE — The ordinates for the annual cost can also be drawn on log scale.

FIG. 1 HYDRO-ECONOMIC ANALYSIS — A TYPICAL DIAGRAM

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