IS 7784-2-4 (1999): Design of Cross Drainage Works - Code of Practice, Part 2: Specific Requirements, Section 4: Level Crossings [WRD 13: Canals and Cross Drainage Works]

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IS 7784 (Part 2/Sec 4) : 1999

(Reaffirmed 2004)

भारतीय मानक

आर-पार जल निकास कार्यों के डिजाइन — रीति संहिता

भाग 2 विशिष्ट अपेक्षाएँ

अनुभाग 4 लेवेल क्रासिंग

(पहला पुनरीक्षण)

Indian Standard

DESIGN OF CROSS DRAINAGE WORKS — CODE OF PRACTICE

PART 2 SPECIFIC REQUIREMENTS

Section 4 Level Crossings

(First Revision)

ICS 93.160

BUREAU OF INDIAN STANDARDS
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Price Group 2

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Cross Drainage Works Sectional Committee had been approved by the River Valley Division Council.

This standard is published in two parts. Part 1 of this standard covers general requirements for the design of cross drainage works. Part 2 of this standard covers specific requirements and has been published in five sections listed below:

Section 1 Aqueducts

Section 2 Super passages

Section 3 Canal syphons

Section 4 Level crossings

Section 5 Syphon aqueducts

This standard (Part 2/Sec 4) covers specific design requirements of level crossings.

Level crossings are cross drainage works involving intermixing of irrigation and drainage water and are provided where the irrigation channel and the drainage channel approach each other practically at the same bed levels. These are generally provided when a sizable carrier channel crosses a large drainage channel which carries a high discharge during floods and when syphoning of either of the two is prohibitive on consideration of economy or non-permissibility of head loss through syphon barrels.

In level crossings advantage of the perennial drainage discharge is often taken to augment the supplies into the outgoing portion of the canal by creating an impounding reservoir.

Level crossings have certain disadvantages as compared to other types of cross drainage works. These are:

a) Higher maintenance cost due to extra staff for regulation and provision of gates structures.

b) Greater risk to the safety of carrier channel canal on account of the failure of human element in the regulation and operation of the gated structures.

c) Intermixing of two waters which may result in heavier sediment discharge into outgoing carrier channel.

This standard was first published in 1980. Since then changes have occurred in technology and field practice. These changes led to the revision of Part 1 of the standard which was revised in 1993. Consequent to its revision the standard is being revised to align it with the revised version of Part 1.

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, shall 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 OF CROSS DRAINAGE WORKS — CODE OF PRACTICE

PART 2 SPECIFIC REQUIREMENTS

Section 4 Level Crossings

(First Revision)

1 SCOPE

This standard (Part 2/Sec 4) deals with the specific requirements of the design of level crossing of a carrier channel and drainage channel.

2 REFERENCES

The standards given in Annex A contain provisions which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated in Annex A.

3 TERMINOLOGY

For the purpose of this standard the definitions given in IS 4410 (Part 15/Sec 5) shall apply.

4 DATA FOR DESIGN

For the design of a level crossing, the specific data as refferred in IS 7784 (Part 1) shall be made available.

5 GENERAL LAYOUT

5.1 The layout of the level crossing shall be so fixed that the drainage channel as far as possible crosses the carrier channel at right angles.

5.2 All level crossings essentially comprise of a combination of all or any of the following regulators depending upon the site requirements (Fig. 1):

a) *Canal Inlet Regulator (A)* — A regulator across the incoming end of the carrier channel to prevent submergence of the carrier channel and the surrounding area by the back water of the drainage when it is in flood. This also prevents sediment of the drainage channel getting deposited in the tail reaches of the incoming carrier channel.

b) *Drainage Inlet Regulator (B)* — A regulator across the drainage inlet upstream of the crossing to prevent wastage of irrigation water and to prevent submergence of the area in the vicinity by spilling over into the drainage valley during lean periods. The regulator could be replaced with a simple raised crest with reduced height of gates or without gates. The raised crest induces in the drainage, tendency of sediment deposition on the upstream and heavy retrogression on the downstream of the level crossing. This factor shall be kept in view, while making a choice between the regulator and raised crest.

c) *Canal Outlet Regulator (C)* — A regulator at the head of the outgoing reach of the carrier channel serving as a head regulator to control and regulate the discharge.

d) *Drainage Outlet Regulator (D)* — A regulator across the drainage channel just on the downstream side of the crossing to maintain a pond for controlling the supply into the outgoing carrier channel. This also serves as an escape regulator for the carrier channel. A small dam with proper spillway or a barrage may have to be provided in some cases instead of a cross-regulator depending upon the size of the drainage channel. Provision of automatic escape and/or automatic semi-automatic operated gates should be made if the situation warrants. In case a high crest is provided in this regulator, requirement of a suitable sediment excluding device should also be considered.

5.3 Depending upon the topography of the area and the local constraints either or both of the regulators *A* and *B* may be omitted.

5.3.1 If the drainage has a steep bed slope such that the H F L (after accounting for the afflux) remains

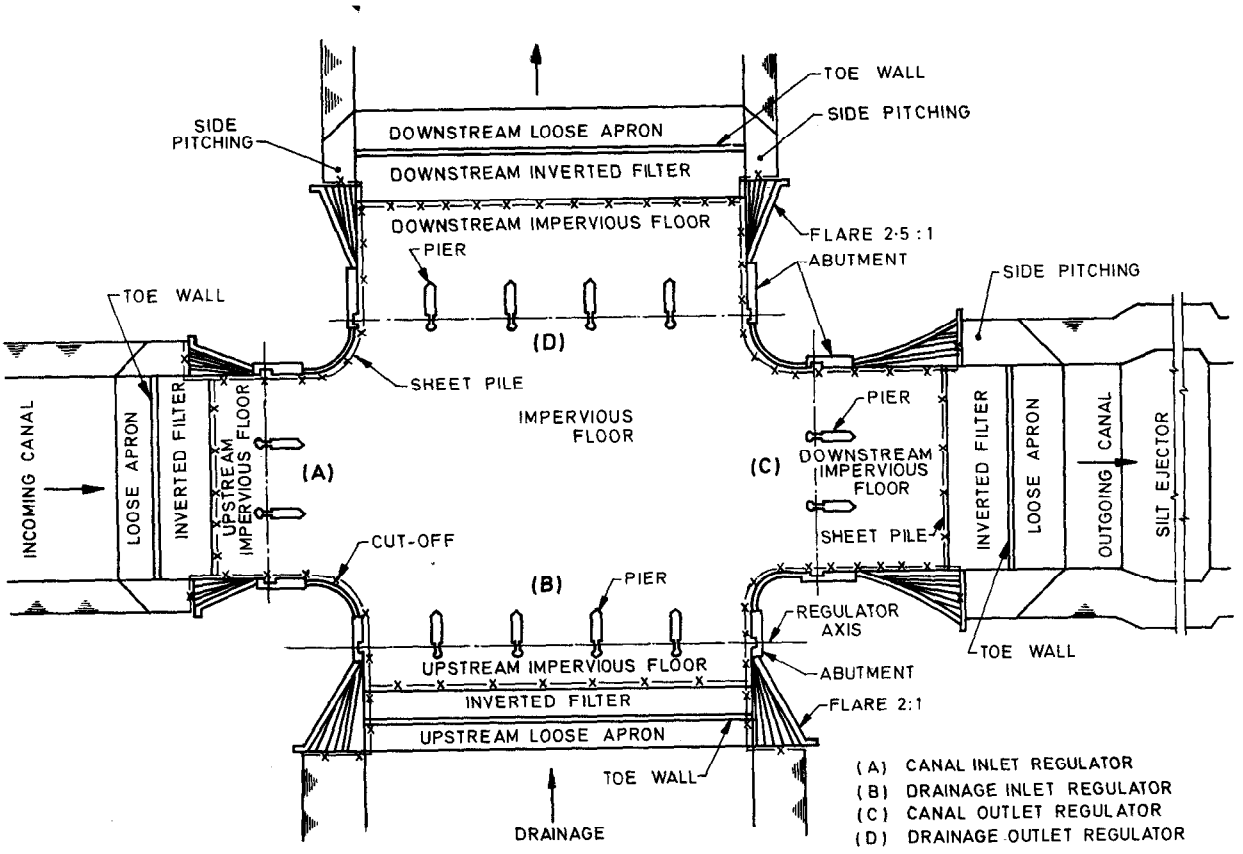

FIG. 1 TYPICAL LAYOUT PLAN OF LEVEL CROSSING

lower than the carrier channel banks, regulator *A* may be omitted. The back water of the drain in floods shall, in such a case, remain confined with in the banks of the incoming carrier channel portion and may not be required to be shut out by means of a regulator. However omission of regulator *A* may result into deposition of sediment in some length of the incoming carrier channel. This factor shall be kept in view while deciding about the omission of regulator *A*.

5.3.2 If the drainage flow is perennial or longlived an impounding reservoir would have to be created to feed the outgoing carrier channel portion. In such a case, regulator *B* is not required and regulator *D* shall be replaced by a small dam with proper spillways or a proper barrage/weir. Such a work may also serve as a balancing reservoir for a carrier channel carrying discharge for generation of hydroelectric power. Even if the drainage flow is non-perennial and the drainage channel has a well defined section and steep bed slope, regulator *B* may be omitted. In such a case when the carrier channel is running and the drainage is dry, back flow of carrier channel water would remain confined within the drainage banks upstream of the crossing.

5.3.2.1 The reservoir delays the passage of extra supply down the outgoing carrier channel end, which in normal cases is not a serious matter. However, when the discharge of the carrier channel is small as compared to that of drainage, this factor may have an important bearing on the decision to provide or omit drainage inlet regulator.

5.3.2.2 To enable running of the carrier channel reach upstream of the drainage crossing even when the drainage channel is in flood and H F L is higher than the carrier channel full supply level, an escape should be provided by the side of the carrier channel inlet regulator with a suitable outfall downstream into the drainage channel.

5.3.3 Ordinarily the drainage regulator remains closed except when the drainage channel is in flood. Suitable outlets should be provided in the regulator to meet the existing irrigation commitments further downstream.

6 DESIGN DISCHARGE OF DRAINAGE CHANNEL

6.1 For design discharge of drainage channel, reference be made to the provisions of IS 7784 (Part 1).

7 HYDRAULIC DESIGN

7.1 Waterway

7.1.1 Provisions of IS 7784 (Part 1) shall govern the fixing of the waterway of the drainage channel, afflux and depths of scour. A tighter waterway is preferable to ensure prevention of shoaling in the drainage channel upstream of the crossing. This is subject to the afflux permissible in accordance with IS 7784 (Part 1).

7.2 Cut-offs

7.2.1 Cut-offs should be provided upstream of regulators *A* and *B* and downstream of regulators *C* and *D*. Where both the regulators *A* and *B* are provided, these should continue along the wings so as to form a complete box (Fig. 1).

7.2.2 When either regulator *A* or *B* or both are omitted, cut-offs should be provided at the upstream and downstream ends of the floors of the regulators. The cut-offs should continue along the wings, so as to form complete boxes at each regulator.

7.2.3 The depth of cut-offs shall be decided from the considerations of scour and safe exit gradient.

7.3 Impervious Floor

7.3.1 The design of the structures mentioned in 5.2(d) and 5.3.2 shall be governed by the provisions of IS 6966 (Part 1) and IS 11130. In such a case regulator *B* would not be required. Regulators *A* and *C* should be designed as two independent head regulators governed by the provisions of IS 6531. The floor of regulators, cut-offs, etc, of regulators *A* and *C* should be designed as for a head regulator for the condition when the drainage channel is in flood and the carrier channel portion is dry.

7.3.2 In cases where both regulators *B* and *D* across the drainage channel are necessary, a continuous inpervious floor shall be provided at the carrier channel bed level in the intervening space between the four regulators. This floor shall be in continuation of the upstream or downstream floors of the four regulators, as the case may be.

7.3.3 The thickness of impervious floor in the intervening portion between the four regulators shall be estimated depending upon the closure of gates of carrier channel and drainage regulators.

7.3.4 The impervious floor of the incoming carrier channel portions on the carrier channel side of regulator *A* and the cut-off shall be designed as a downstream floor and downstream cutoff respectively, for the conditions when the drainage channel is in flood and the carrier channel is dry.

7.3.5 The thickness of impervious floor on the upstream of regulator *B* shall be designed for the condition when the carrier channel is running full and the drainage channel is dry with the regulator fully closed. The depth of upstream cut-off shall be designed for the scour, when the drainage channel is in flood and from the consideration of safe exit gradient for the condition when the carrier channel is running full and the drainage channel is dry with the regulator fully closed. The regulator *B* shall be designed in accordance with IS : 6966 (Part 1) and IS 6531.

7.3.6 Regulators *C* and *D* shall be designed in accordance with IS 6531 and IS 6966 (Part 1) respectively. The entire impervious floors in the carrier channel and drainage channel shall serve as upstream floors for regulators *C* and *D* respectively. Similarly, the cut-offs in the carrier channel and drainage channel on the upstream and downstream ends shall serve as upstream and downstream cut-offs respectively for regulators *C* and *D*. The downstream floor of regulator *C*, shall be designed for the condition when the drainage channel is in flood and the carrier channel is dry. The depth of downstream cut-off of the regulator *C* shall be designed from the consideration of scour, when the carrier channel is running with full supply and safe exit gradient for the condition when the drainage channel is in flood and carrier channel is dry with the gates of regulator *C* fully closed. The depth of downstream cut-off of regulator *D* shall be decided from the consideration of scour when the drainage channel is in flood and safe exit gradient when the carrier channel is running with full supply and drainage channel is dry. The thickness of the downstream floor of regulator *D* shall be designed for the condition when the carrier channel is running with full supply and drainage channel is dry.

7.4 Floor Protection Works

Suitable filter and loose apron etc, shall be provided beyond the impervious floor in accordance with IS 6531.

7.5 Miscellaneous Works

7.5.1 In accordance with the recommemdations of IS 7784 (Part 1), the design of floor thickness and cut-off depths should be tested on "three dimensional Electrical Anology Model" for the various operating conditions as the subsurface flow shall have predominantly a three dimensional character in this case.

7.5.2 The problem of sediment entry into the outgoing carrier channel portion shall be given careful consideration. Suitable silt exclusion devices may be provided, if necessary. (Reference may be made to IS 6004 for details.)

8 STRUCTURAL DESIGN

For the structural design of level crossings reference may be made to IS 11130.

9 MISCELLANEOUS DETAILS

9.1 In case the drainage carries objectionable floating debris, suitable trash racks with raking arrangements should be provided at the entry of the carrier channel outlet regulator or drainage inlet regulator depending upon the site conditions and economy.

9.2 With a view to allowing for differential settlement, if any, between the floor on the one hand and piers abutments and wings on the other, the foundations of the latter are generally separated from the floor by means of a joint. The joint should be in accordance with IS 3370 (Part 1). The location of the water stops should be in accordance with IS 7784 (Part 1).

9.3 Gates

Provisions of IS 5620 and IS 6938 shall govern the design of gates and hoists.

ANNEX A

(*Clause* 2)

IS No.	*Title*
3370 (Part 1) : 1965	Code of practice for concrete structure for the storage of liquids : Part 1 General requirements
4410 (Part 15/ Sec 5) : 1992	Glossary of terms relating to river valley projects : Part 15 Canal structure, Section 5 Cross drainage works (*first revision*)
5620 : 1985	Recommendations for structural design criteria for low head slide gates (*second revision*)
6004 : 1980	Criteria for hydraulic design of sediment ejector for irrigation and power canfals (*first revision*)
6531 : 1992	Criteria for design of canal head regulators (*first revision*)
6938 : 1989	Code of practice for design of rope drum and chain hoists for hydraulic gates (*first revision*)
6966 (Part 1) : 1989	Guidelines for hydraulic design of barrages and weirs : Part 1 Alluvial reaches (*first revision*)
7784 (Part 1) : 1993	Code of practice for design of cross drainage works : Part 1 General features (*first revision*)
11130 : 1984	Criteria for structural design of barrages and weirs