IS 7784 (Part 2/Sec 2) : 2000
(Reaffirmed 2004)
Edition 2.1
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भारतीय मानक

आर-पार जल निकास कार्य के डिजाइन रीति संहिता

भाग 2 विशिष्ट अपेक्षाएँ

अनुभाग 2 सुपरपैसेज

(पहला पुनरीक्षण)

Indian Standard

CODE OF PRACTICE FOR DESIGN OF CROSS DRAINAGE WORKS

PART 2 SPECIFIC REQUIREMENTS

Section 2 Superpassages

(First Revision)

(Incorporating Amendment No. 1)

ICS 93.160

B U R E A U O F I N D I A N S T A N D A R D S
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NEW DELHI 110002

Price Group 2

Cross Drainage Works Sectional Committee, WRD 17

FOREWORD

This Indian Standard (Part 2/Sec 2) (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 Water Resources Division Council.

Cross drainage works are structures which are constructed to negotiate an aligned carrier canal over, below or at the same level of a drainage or another carrier canal. With the knowledge now available, it is necessary to formulate codes of practice for designs, constructions, inspection and maintenance of cross drainage works to secure uniform standard.

This standard is published in two parts: Part 1 of this standard covers general requirements of the design of cross-drainage works, Part 2 of this standards is being published in the five sections. The sections are listed below:

Section 1 Aqueducts
Section 2 Superpassages
Section 3 Canal syphons
Section 4 Level crossings
Section 5 Syphon aqueducts

This section covers specific design requirements of superpassages.

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

This edition 2.1 incorporates Amendment No. 1 (July 2005). Side bar indicates modification of the text as the result of incorporation of the amendment.

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

CODE OF PRACTICE FOR DESIGN OF CROSS DRAINAGE WORKS

PART 2 SPECIFIC REQUIREMENTS

Section 2 Superpassages

(First Revision)

1 SCOPE

This standard (Part 2/Sec 2) deals with the specific requirements of the design of superpassages.

2 REFERENCES

The following standards contain provisions which through reference in this text, constitute provisions of this standards. 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 posibility of applying the most recent editions of the standards indicated below:

IS No.	*Title*
4410 (Part 15/Sec 5) : 1992	Glossary of terms relating to river valley projects: Part 15 Canal structures, Section 5 Cross-drainage works (*first revision*)
7784 (Part 1) : 1993	Design of cross drainage works—Code of practice: Part 1 General features (*first revision*)

3 TERMINOLOGY

3.0 For the purpose of this standard, the terms as defined in IS 4410(Part 15/Sec 5) shall apply.

3.1 Syphon Superpassage

It is a cross drainage work to carry drainage or the natural stream over the canal normally with the full supply level (F.S.L) of the canal below the bottom of the trough (*see* Fig. 1 for typical layout).

4 GENERAL CHARACTERISTICS

4.1 In general, there should be sufficient free board available between the F.S.L. of canal and the under-side of drainage trough. Recommended values are given below. Submergence of the trough to some extent under special site conditions may be suitably considered by the designer.

Sl No.	*Discharge of Canal* cumecs	*Free Board* mm
i)	Below 3	200
ii)	3 and above but below 30	300
iii)	30 and above but below 300	450
iv)	300 and above	600

4.1.1 A minimum free board in the trough is recommended as below:

Sl No.	*Drainage Discharge* cumecs	*Free Board* mm
i)	Up to 30	400
ii)	More than 30 up to 100	500
iii)	More than 100 up to 300	600
iv)	More than 300*	750

*Higher values of freeboard may be provided depending upon the drainage characteristics.

4.2 Due to steep slope in the bed of the drainage, it may be necessary to provide a suitable fall downstream of the trough carrying the water of the stream.

4.3 In suitable circumstances, it is recommended that the bed level of the drainage be lowered at entry and exit of superpassage thereby increasing velocity and reducing the cost of super- structure.

5 DATA FOR DESIGN

5.1 Hydraulic Data

a) *Canal*

Hydraulic design data shall be made available as given in IS 7784 (Part 1). In the case of syphon superpassages the following data shall also be made available in addition:

1) Side slopes,
2) Allowable head loss,
3) Whether canal is lined and if so, the lining, material.

4) Free board,

5) Velocity in canal, and

6) The alignment of canal for at least 100 m distance beyond the limits of cross drainage work on both sides.

b) *Stream or Drain*

Data as required in IS 7784 (Part 1) shall be made available.

6 DESIGN CRITERIA

6.1 Hydraulic Design

The problem involved under this head may be further classified as under:

a) Surface flow, and

b) Subsurface flow.

6.1.1 *Design Features in Respect of Surface Flow*

The provisions as given in IS 7784 (Part 1) shall apply.

6.1.2 *Design Features in Respect of Subsurface Flow*

a) Safety of the structure against residual uplift pressure of the percolating water acting on the bottom of the floor; and

b) Check for exit gradient or safety of the structure against piping.

6.2 Structural Design

6.2.1 The various loadings assumed in the design of box conduits shall consist of the following:

a) Empty self weight of the structure,

b) Super-imposed loads,

c) Surcharge loads,

d) Full internal water pressure,

e) Soil reaction and up-lift pressure, and

f) Earth loads on sides.

6.2.2 The superpassage shall be designed for conditions given in **6.2.2.1** to **6.2.2.3**.

6.2.2.1 *Canal and drainage full*

a) Bed of the canal should be checked for vertical loads,

b) Bottom slab of the drainage bed should also be considered for H.F.L, loading due to water and loading due to surcharge of earth and partial silt load, and

c) Side walls of the drainage trough should be designed for partial silt load at H.F.L conditions.

6.2.2.2 *Canal and drainage full*

Bed slab of the canal should be designed for the earth reaction and uplift pressures in H.F.L conditions of the drainage.

6.2.2.3 *Canal full and drainage dry*

For 25 percent submergence, the bottom slab of the drainage may be designed for bursting.

7 DETERMINATION OF WATERWAY OF THE DRAIN

7.1 Section of the Trough

The section of the trough should permit a scouring velocity at maximum observed flood. A velocity of 2 to 3 m per second is normally permissible.

The section of trough should be determined by equating energies in the trough and the natural stream at maximum observed flood.

7.2 In the case of earthen troughs, the velocity through the trough should not be more than the critical velocity.

8 CONTRACTION OF THE CANAL SECTION

The section of the canal may be suitably flumed keeping in view the permissible loss of head and economy.

9 ENERGY LOSS DUE TO THE STRUCTURE

9.1 Afflux should be such that it does not exceed the limits of submergence and tolerances of the environments. Energy loss should be determined in acordance with IS 7784 (Part 1).

9.2 Total energy loss in the drainage course will in turn cause an afflux which should be kept within practicable limits.

9.3 In case the head available is more than the total energy loss as in the streams or drains in the upper reaches in sub-mountainous tracts, surplus head can be disposed off by providing suitable energy dissipators.

10 DETERMINATION OF HIGH FLOOD LEVEL

High flood level (H.F.L) calculated or observed, whichever is more at the centre line of the crossing, water surface slope of the stream or drain and the total length of the work being known, the H.F.L at the upstream and downstream of the work can be determined, taking into consideration the parameters at the site.

11 ENERGY DISSIPATION AT THE DOWNSTREAM END

11.1 Energy dissipators at the d/s side shall be provided with arrangements given below taking into consideration the discharge and velocity of flow in the stream and drops, if any, to be negotiated:

a) Solid apron,
b) Water cushion,
c) Stilling basins,
d) Pitching, and
e) Staggered blocks, etc.

12 U/S AND D/S TRAINING WALLS

Where the stream width has been restricted at the crossing, a minimum splay of 2:1 and 3:1 on the u/s and d/s sides may be provided respectively.

13 CUT-OFFS AND SCOURS

13.1 Cut-off walls shall be provided at the end of the solid floor on the u/s and d/s sides.

13.2 The u/s and d/s cut-offs should generally be provided to cater for scour of 1.25 *R*, and 1.5 *R* respectively where *R* is the depth of scour, depending upon the nature of sub-soil.

13.3 Scour depth should be calculated in accordance with IS 7784 (Part 1).

14 TOTAL FLOOR LENGTH

14.1 The total length of the impervious floor of canal from u/s to the d/s solid aprons (which includes dissipation arrangements, if any) shall be fixed in conjunction with the depth of cut-off to satisfy the requirement of exit gradient under the condition when drain is at H.F.L and canal is empty, and the economy.

14.2 The impervious floor length of the drainage shall be such that the exit gradient at canal cutoff should be within permissible limits.

14.3 The minimum thickness of solid floor shall be kept as 300 mm.

15 PROTECTIVE WORKS

15.1 Upstream Pervious Protection

15.1.1 Just beyond the end of impervious floors, rubble or blocks of cement concrete of suitable size shall be provided so that they will not get dislodged during the maximum flow.

15.1.2 The minimum length of the upstream protection shall be kept equal to *D*, the design depth of scour below the floor level.

15.2 Downstream Pervious Protection

15.2.1 Rubble or blocks of cement concrete of suitable size shall be provided just beyond the d/s end of impervious floor so that they will not get dislodged during the maximum flood flow. The stones or blocks shall be so arranged as to relieve the pressure at the ends of the impervious floor of the canal. Initial part of the pervious protection may be provided with a proper filter.

NOTE — For beds of streams and drains which are not easily susceptible to scour, the protection may be minimized suitably.

15.2.2 The minimum length of the d/s protection shall be kept equal to 1.5 *D*, where *D* is the design depth of scour below the floor level.

15.3 Launching Apron

Beyond the pervious protection on the u/s and d/s of the work, bed may be protected with brickbats or loose boulders or stones.

15.3.1 The quantity of loose stone protection required shall be determined on scour considerations.

15.3.2 The minimum thickness of the loose stone protection shall be equal to the thickness of pitching on slopes.

NOTE — The design of protection works shall comply the provision of IS 7784 (Part 1).

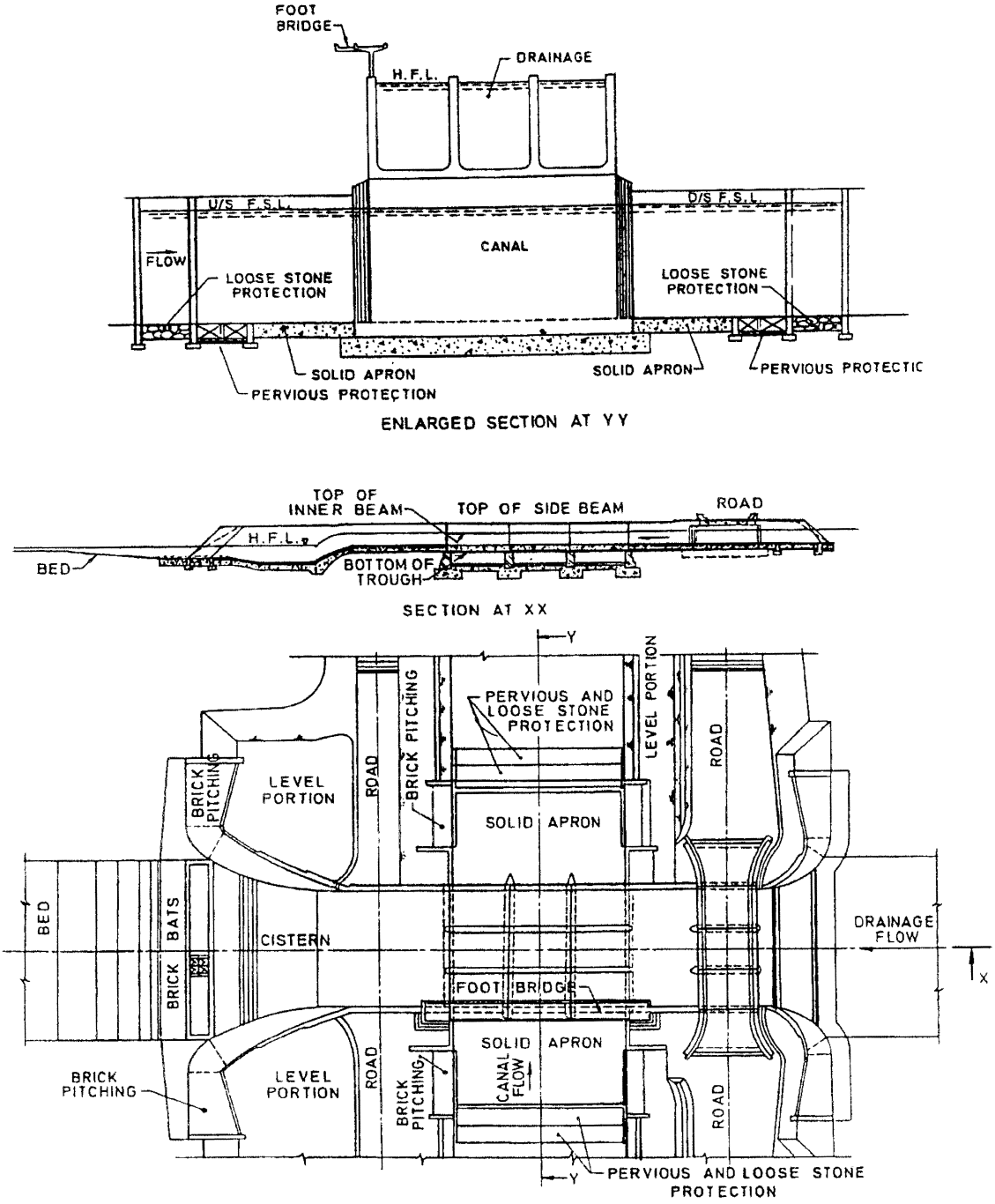

FIG. 1 A TYPICAL LAYOUT OF A SUPERPASSAGE

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