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(Reaffirmed 1997)

Dams (Overflow & Non-overflow) Sectional Committee, BDC 53 : Masonry and Concrete Dams Subcommittee, BDC 53 : 1 Doc : BDC 53 (2972)

Indian Standard

CODE OF PRACTICE FOR PROVISION OF WATERSTOPS AT TRANSVERSE CONTRACTION JOINTS IN MASONRY AND CONCRETE DAMS

0. Foreword

0.1 This Indian Standard was adopted by the Bureau of Indian Standards on 30 October 1987, after the draft finalized by the Dams (Overflow and Non-overflow) Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 The opening of the contraction joints provides passages through the dam which unless sealed, would permit the leakage of water from the reservoir to the downstream face. To stop this leakage, waterstops consisting of metal strips, asphalt, rubber or PVC should be installed in the joints adjacent to the upstream face.

0.3 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, shall be rounded off in accordance with IS : 2 - 1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. Scope

1.1 This standard deals with provision of waterstops across ungrouted transverse contraction joints in masonry and concrete dams.

2. Types of Waterstops

2.1 The following types of waterstops are generally used:

a) Metal waterstops,

b) Rubber waterstops, and

c) PVC waterstops.

2.2 Asphalt waterstops are used as secondary waterstops to those listed in **2.1**.

3. Metal Waterstops

3.1 *Types* — The following two types of metal waterstops are normally used:

a) Copper waterstops, and

b) Stainless steel waterstops.

3.1.1 *Copper waterstops*

3.1.1.1 *Material* — The waterstops shall be made out of strips of minimum thickness 1·5 mm conforming to IS : 1972 - 1977†.

3.1.1.2 *Shape and dimensions* — The following two shapes are generally used:

a) Z shape, and

b) M shape.

The details of thair shapes and dimensions are given in Fig. 1 (a) and 1 (b).

3.1.2 *Stainles steel waterstops*

3.1.2.1 *Material* — The waterstops shall be made out of strip 1.5 mm thick conforming to IS : 6911 - 1972‡.

*Rules for rounding off numerical values (*revised*).
†Specification for copper plate, sheet and strip for industrial purpose (*first revision*).
‡Specification for stainless steel plate sheet and strip.

Adopted 30 October 1987 | | Gr 4

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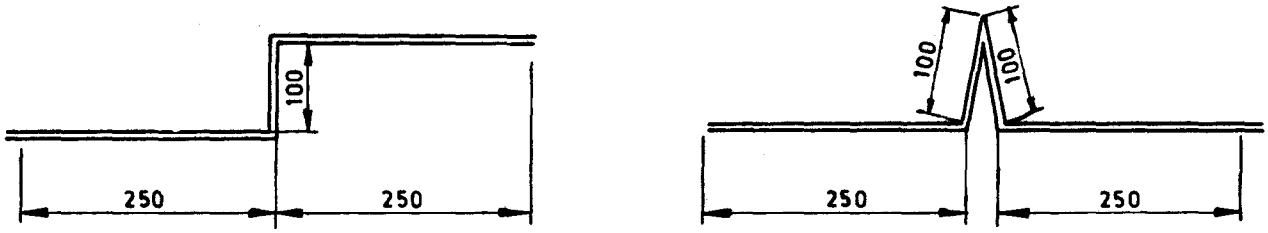
3.1.2.2 *Shape and dimensions* — The shapes and dimensions of stainless steel waterstops are the same as given in **3.1.1.2** [(Fig. 1 (a) and 1 (b)].

4. Rubber Waterstops

4.1 *Material* — The waterstops should be fabricated from natural rubber and shall meet the requirements given in Table 1.

4.2 *Testing Procedure* — The material shall be tested in accordance with the procedure specified in relevant parts of IS : 3400*.

4.3 *Shape and Dimensions* — The details of shape and dimensions of rubber waterstops are given in Fig. 2.

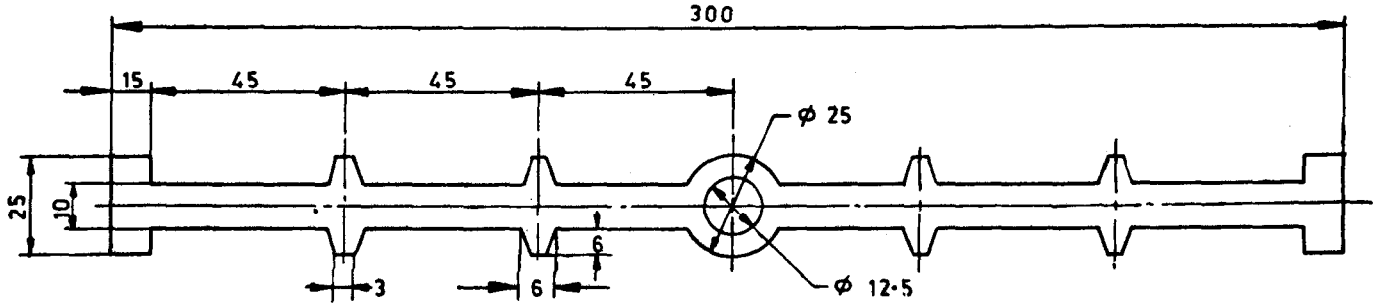


1A DETAILS OF Z-SHAPE METAL WATER STOP

1B DETAILS OF M-SHAPE METAL WATER STOP

All dimensions in millimetres.

FIG. 1 METAL WATERSTOPS



Note — The above are minimum dimensions in millimetres.

FIG. 2 DETAILS OF RUBBR/PVC WATERSTOPS

5. PVC (Polyvinyl Chloride) Waterstops

5.1 *Material* – The waterstop should be fabricated from a plastic compound, the basic resin of which shall be polyvinyl chloride. The compound shall contain any additional resins, plasticizers, inhibitors or other materials such that when the material is compounded it shall meet the requirements given in Table 1.

5.2 *Testing Procedure* — The material shall be tested in accordance with the procedure specified in relevant parts of IS : 8543†.

5.3 *Shape and Dimensions* — The shape and dimensions of PVC waterstops are given in Fig. 2.

6. Asphalt Waterstops

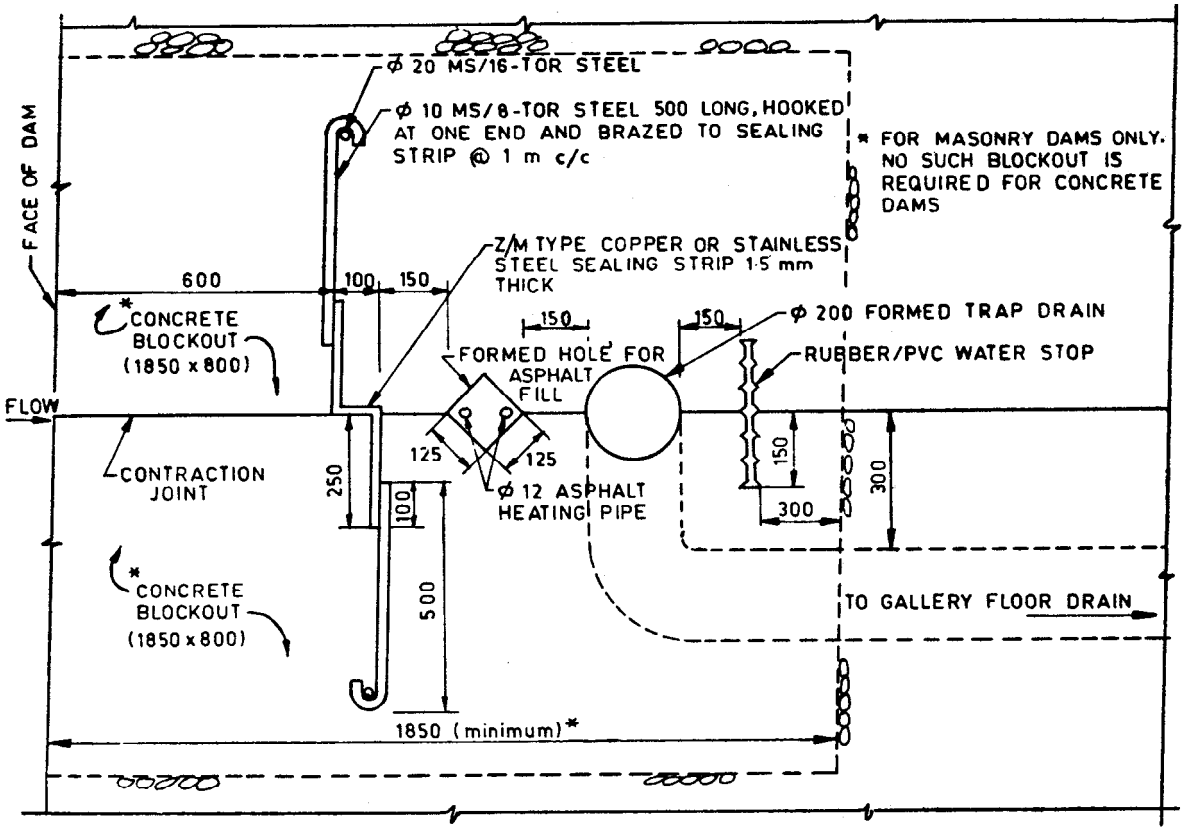
6.1 An asphalt waterstop is constructed by forming a well of square opening across the contraction joints and filling the opening with an asphaltic compound. The well may be fitted in advance with a steam pipe or an electrical heat conductor for reliquefying the asphalt.

*Methods of test for vulcanized rubbers.
†Methods of testing plastics.

TABLE 1 PERFORMANCE REQUIREMENTS OF RUBBER/PVC WATERSTOPS

(*Clauses* 4.1 *and* 5.1)

Sl No.	Characteristic	Unit	Value
i)	Tensile strength	N/mm²	11·6, *Min*
ii)	Ultimate elongation	%	300, *Min*
iii)	Tear resistance	N/mm²	4·9, *Min*
iv)	Stiffness in flexure	N/mm²	2·46, *Min*
v)	Accelerated extraction		
	a) Tensile strength	N/mm²	10·5, *Min*
	b) Ultimate elongation	%	250, *Min*
vi)	Effect of alkali : 7 days		
	a) Weight increase	%	0·10, *Max*
	d) Weight decrease	%	0·10, *Max*
	c) Hardness change	Point	±5
vii)	Effect of alkali : 28 days		
	a) Weight increase	%	0·40, *Max*
	b) Weight decrease	%	0·30, *Max*
	c) Dimension change	%	±1



All dimensions in millimetres.

FIG. 3 SECTIONAL PLAN AT CONTRACTION JOINT [DOWEL BARS BETWEEN CONCRETE/MASONRY FACE OF THE BLOCKOUT NOT SHOWN (*See* Clause 7.3)]

6.2 Recommended specifications of asphalt are given below:

a) Density	1015 - 1065 kg/m³
b) Penetration at 25°C	200 - 300
c) Softening point (Ring and ball test)	80 - 90°C
d) Brittleness test on 22 mm² specimen, at 5°C, energy absorbed	0·97 kg.m

6.3 *Shape and Dimensions* — The location, shape and dimensions of asphalt waterstop generally followed are given in Fig. 3.

7. Installation of Waterstops

7.1 The metal waterstops shall be erected in place with the help of anchor rods.

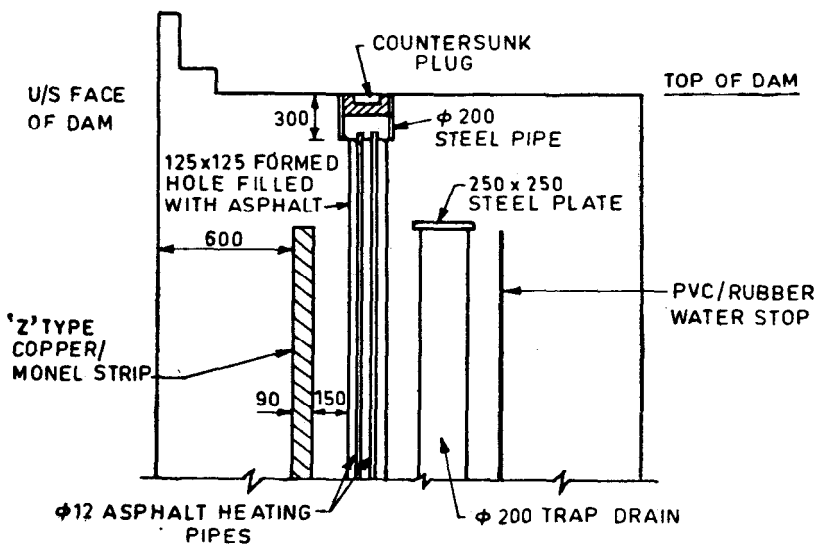
7.2 In the case of masonry dams, the surface adjacent to the blockouts (shown by dotted lines in Fig. 3) shall be irregular and the joints in the masonry shall be raked out when mortar is green, with some stone protruding beyond dotted lines regularly in both directions. No such blockouts shall be provided in concrete dams where concreting on either side of the water seals is done along with the concreting of the rest of the concreting block.

7.3 25 mm dia dowel bars, 1 500 mm long (500 mm in concrete and 1 000 mm in masonry) 500 mm c/c in both directions shall be provided at the concrete/masonry interface of the blockout in case of a masonry dam to prevent shrinkage crack at the interface.

7.4 The blockout may be concreted in lifts not more than 1·5 m. Minimum grade of concrete to be used in the blockout shall be M 20 (*see* IS : 456 - 1978*).

7.5 The blockout of one block may be concreted first and the joint face given a coat of coaltar black paint conforming to IS : 290 - 1961† and then only the blockout of the second block should be concreted so as to have a clear contraction joint.

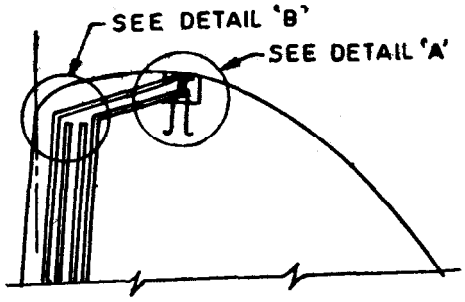
7.6 Typical details of waterstop arrangement (at contraction joints between two monoliths of a dam) near the top of a non-overflow section are shown in Fig. 4, near the crest of an overflow section in Fig. 5 and near the bottom of the dam in Fig. 6.

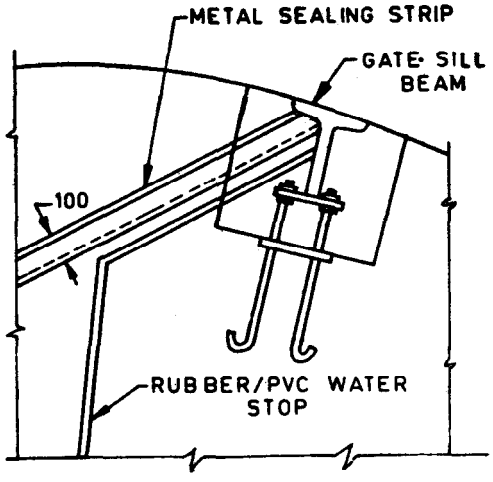


All dimensions in millimetres.

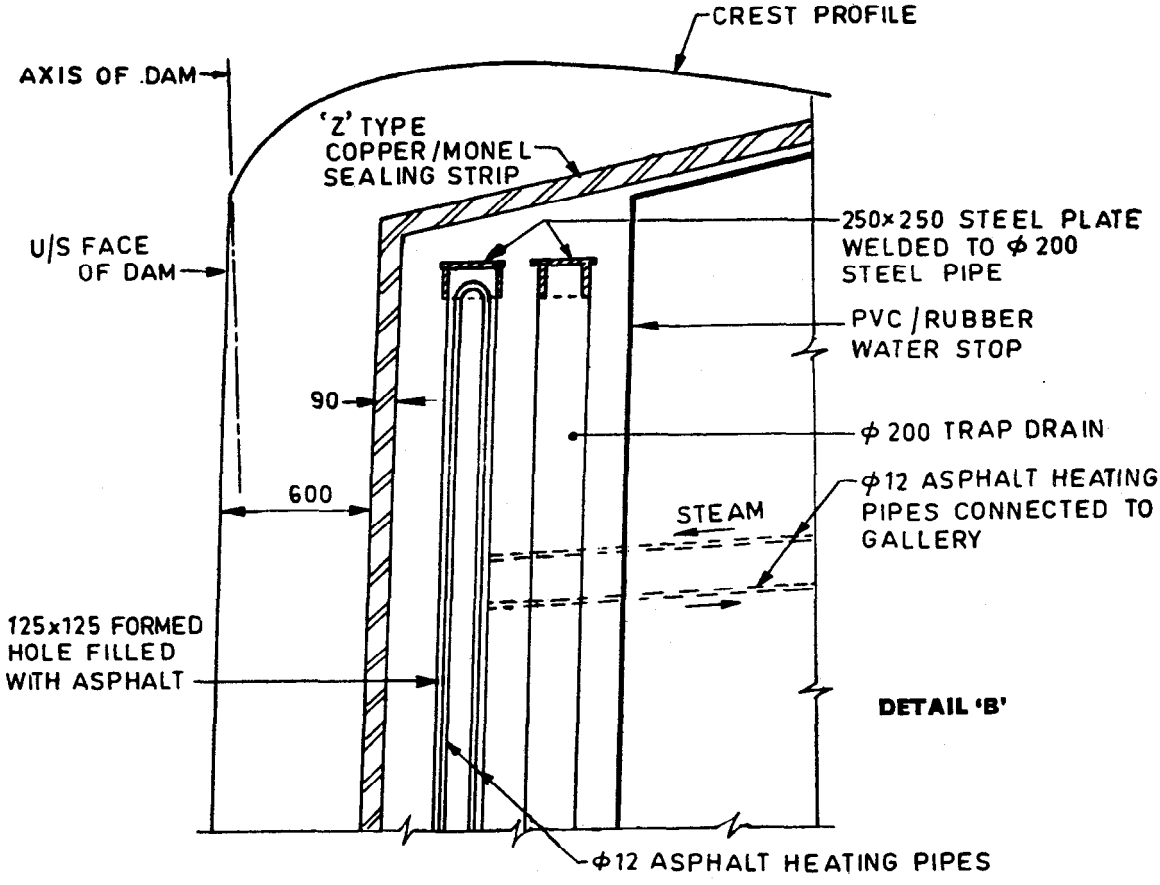
FIG. 4 TYPICAL WATERSTOP DETAILS NEAR THE TOP OF NON-OVERFLOW SECTION OF DAM

*Code of practice for plain and reinforced concrete (*third revision*).
†Specification for coaltar black paint (*revised*).





DETAIL 'A'



DETAIL 'B'

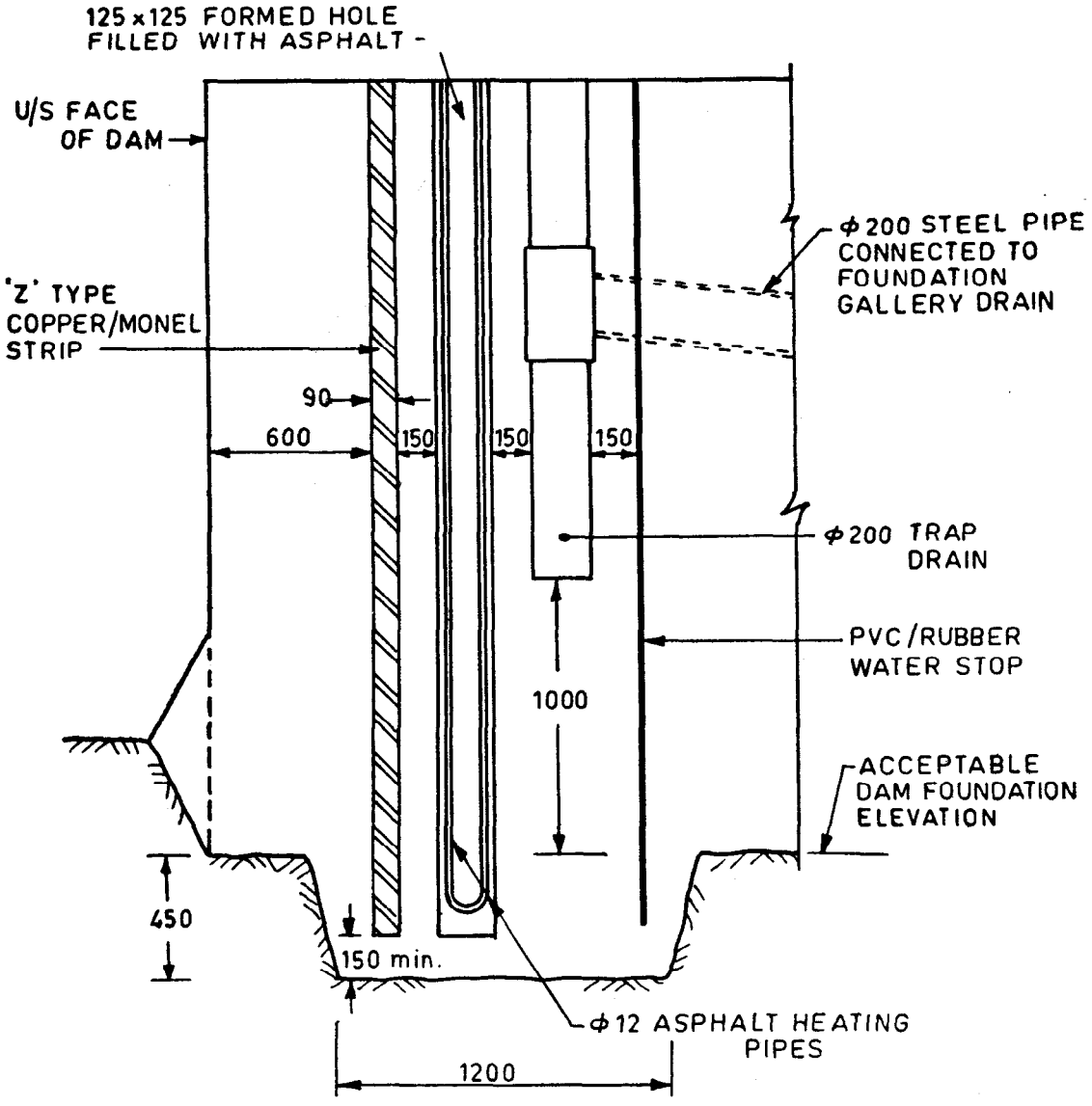
All dimensions in millimetres.

FIG. 5 TYPICAL WATERSTOP DETAILS NEAR THE CREST OF OVERFLOW SECTION

7.7 Rubber/PVC waterstops shall be provided around galleries/adits at the contraction joint between two monoliths of a dam as shown in Fig. 7.

8. Jointing .

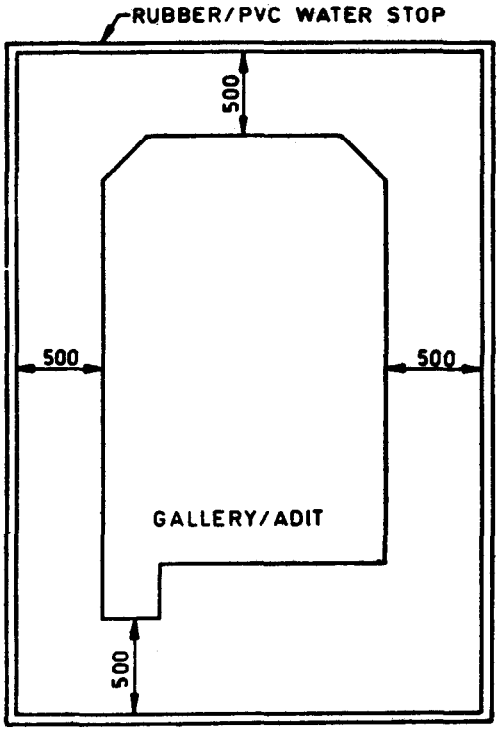
8.1 Rubber/PVC waterstops shall be jointed in straight reaches only.



All dimensions in millimetres.

FIG. 6 TYPICAL WATERSTOP DETAILS NEAR BOTTOM OF DAM

8.2 Jointing in copper/stainless water seals shall be by careful brazing/welding respectively so as to form a continuous water-tight diaphragm.



All dimensions in millimetres.

FIG. 7 RUBBER/PVC WATERSTOP AROUND GALLERY/ADIT AT CONTRACTION JOINTS