BUREAU OF INDIAN STANDARD

भारतीय मानक मसौदा

अस्तरित नहरों में अधोजल निकासी - व्यावहारिक संहिता

Draft Indian Standard

UNDER-DRAINAGE OF LINED CANALS - CODE OF PRACTICE

(*Third Revision of* IS 4558)

Canals and Cross Drainage Works Sectional Committee, WRD 13

Last date for Comments: 22/01/2024

FOREWORD

(*Formal Clause of the foreword will be added later*)

Where a lined canal crosses areas subject to seasonal high groundwater or where the soil is sufficiently water tight to prevent free draining of seepage or leakage from canals, suitable under drainage should be provided to protect their lining. Where the sub-grade is free draining but the area is subject to high groundwater, excessive hydrostatic pressure may be developed, which might be sufficient to damage the lining when canal is empty or its water level is relatively low and groundwater level is high. A similar situation may occur in areas where the canal is lined for reasons other than to prevent seepage and leakage from the canal. The accumulation of water in the soil surrounding the canal may result in localized high groundwater table, which may produce damaging hydrostatic back pressure during the period of rapid drawdown of water level in canal. The water accumulated by means of the under-drainage arrangements should be disposed off preferably by means of natural drainage or, if this is not available, by use of pressure release valves into the canal.

This standard was published in 1968 and was revised in 1983 and 1995. This revision was prepared in the light of experience gained during last six years. In this revision the principal modifications made were in respect of giving specific recommendations for various situations of water table position and type of subgrade. Details of specification for pressure release valves were included in first revision.

The third revision of this standard has been taken for updating the standard w.r.t. the technological advancements…and ……..

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 : 2022. Rules for rounding off numerical values (*second 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.

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1 SCOPE

1.1 This standard covers methods for under-drainage of lined canals.

1.2 This standard does not cover underdrainage of canals in expansive soils which is given in IS 9451.

2 REFERENCES

The standards listed below 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 below:

IS No.	*Title*
4985:2021	Unplasticized Pvc Pipes for Potable Water Supplies Specification (*fourth revision*)
9451 : 2022	Guidelines for Lining of Canals in Expansive Soils (*third revision*)

3 VARIOUS CONDITIONS OF WATER TABLE AND TYPES OF SUBGRADE

3.1 The drainage arrangements to be provided would depend mainly upon the position of the water table and the type of subgrade.

3.2 The water table may have the following positions:

a) Below canal bed level,
b) Between canal bed and full supply level, and
c) Above canal full supply level.

3.3 The subgrade may be of the following types:

a) *Free draining* — Soil comprising gravel with sand, or sandy soil having permeability greater than 10^{-4} cm/sec, that is, K > 10^{-4} cm/sec.

b) *Poor draining* — Soil comprising very fine sand, admixture of sand, silt and clay or soil having permeability between 10^{-4} cm/sec, that is, 10^{-6} cm/sec < K < 10^{-4} cm/sec.

c) *Practically impervious* — Soil comprising homogeneous clays with permeability less than 10^{-6} cm/sec, that is, K < 10^{-6} cm/sec.

Where K is Coeff of Permeability as per Darcy's Equation

4 NECESSITY

4.1 Drainage arrangements should be such that the pressure on lining does not increase beyond the safe limit. Recommended provisions for various conditions are given in **4.2, 4.3** and **4.4.**

4.2 Water Table Below Canal Bed Level

a) *Subgrade free draining* — In this condition there will be no time lag in the dissipation of drawdown pore pressure in the backfill and, as such, no drainage arrangement will be necessary.

b) *Subgrade poor draining* — In this condition because of poor draining subgrade, the backfill will get saturated in course of time due to seepage of water through joints and cracks, and should drawdown occur, pressure will build up behind the lining. This will necessitate a well designed drainage arrangement.

c) *Subgrade practically impervious* — As in **4.2**(b) backfill will get saturated in course of time and in drawdown condition, excessive pressure will build up behind the lining. In this situation the subgrade should be removed to a depth of 600 mm and replaced by sand, murram or suitable pervious material and a well designed drainage arrangement would be necessary.

4.3 Water Table Between Bed and FSL, and Subgrade Either Free Draining, Poor Draining or Practically Impervious

In this case, the soil behind the lining will remain submerged up to the level of the water table, and in saturated condition above the water table as in **4.2**(a) or **4.2**(b). The lining will, therefore, be subject to hydrostatic pressure. Well designed drainage arrangements will, therefore, be necessary. However, if subgrade is practically impervious, it should be removed to a depth of 600 mm and replaced by sand, murram or suitable pervious material.

4.4 Water Table above Canal FSL and Subgrade either Free Draining, Poor Draining or Practically Impervious

In this case, pressures on canal lining will be larger. Therefore, elaborate drainage arrangements will be required. However, in case of practically impervious subgrade,

should be removed to a depth of 600 mm and replaced by sand, murram or suitable pervious material.

5 METHODS OP UNDER-DRAINAGE

5.1 Filter Below Lining

5.1.1 *Water Table below Canal Bed and Subgrade Free Draining*

As mentioned in **4.2**(a) no drainage arrangement is required.

5.1.2 *Water Table below Canal Bed and Subgrade Poor Draining*

In this case 150 to 200 mm thick layer of well designed filter should be provided.

5.1.3 *Water Table below Canal Bed and Subgrade Practically Impervious*

After removal of subgrade and its replacement by suitable pervious material, as mentioned in 4.2(c), no additional filter need be provided.

5.1.4 *Water Table between Canal Bed and FSL and Subgrade Free Draining, Poor Draining or Practically Impervious*

In free draining, as also in poor draining subgrade, 150 mm to 200 mm thick layer of well designed filter as in **4.3** should be provided. However, in case of practically impervious subgrade provisions similar to **5.1.3** should be made.

5.1.5 *Water Table above Canal FSL and Subgrade Free Draining, Poor Draining or Practically Impervious*

In free draining subgrade, 150 mm to 200 mm thick, while in poor draining subgrade, 200 mm to 300 mm thick, layer of well designed filter should be provided.

However, in case of practically impervious subgrade provisions similar to **5.1.3** should be made.

5.2 Pressure Relief Arrangements

5.2.1 *Water Table below Canal Bed and Subgrade Free Draining*

No pressure relief arrangement is required.

5.2.2 *Water Table below Canal Bed and Subgrade Poor Draining*

Bed — Longitudinal and transverse drains (*see* 7) with pressure relief valves (*see* 8) should be provided.

Sides — Pressure relief valves in pockets (*see* 8) filled with filter material should be provided.

5.2.3 *Water Table below Canal Bed and Subgrade Practically Impervious*

Provisions similar to **5.2.2** should be provided.

5.2.4 *Water Table between Canal Bed and FSL, and Subgrade Free Draining, Poor Draining or Practically Impervious*

Provisions similar to **5.2.2** should be provided.

5.2.5 *Water Table above Canal FSL and Subgrade Free Draining, Poor Draining or Practically Impervious*

Bed — Longitudinal and transverse drains (see **7**) with pressure relief valves (see **8**) should be provided.

Sides — Transverse drains (*see* 7) with pressure relief valves (*see* 8) should be provided.

Wherever release of drainage pressure is critical for stability of canal lining, detailed analysis may be carried out to find required seepage arrangement

6 LONGITUDINAL AND TRANSVERSE DRAINS

6.1 Longitudinal Drains

The section of the drain should be trapezoidal with bottom width 500 mm, depth 525 mm and sides as steep as practicable. The drain should be carefully filled up to the bottom of the lining with graded filter with pipe as shown in Fig. 1 and properly compacted so as to form an even bedding for lining. The pipe may be asbestos cement pipe or PVC pipe. It should be perforated. Usually 150 mm dia pipes are used. The perforations/holes should be 12 mm in diameter and should be done by drilling. On an average there should be a minimum of 100 perforations/holes per metre length of pipe and the perforations/holes in adjacent rows should be staggered. The pipe should be properly shrouded with suitable filter.

The number of longitudinal drains should depend on the bed width of canal. In the bed of canal, at least one drain for every 10 m width should be provided. The drains should be placed symmetrically with reference to the centre line of canal.

Care should be taken that the filter does not get clogged during lining.

6.2 Transverse Drains

Transverse drains, where necessary, should be provided in the bed and on the side slopes up to free board level. Section of transverse drains should be the same as that of

longitudinal drains shown in Fig. 1. The drain should be carefully filled up to the bottom of the lining with graded filter as shown in Fig. 1 and properly compacted so as to form an even bedding for lining. The pipe may be asbestos cement pipe or PVC pipe. It should be perforated. Usually 150 mm dia pipes are used. The perforations/holes should be 12 mm in diameter and should be done by drilling. On an average there should be a minimum of 100 perforation/holes per metre length of pipe and the perforations/holes in adjacent rows should be staggered. The pipe should be properly shrouded with suitable filter.

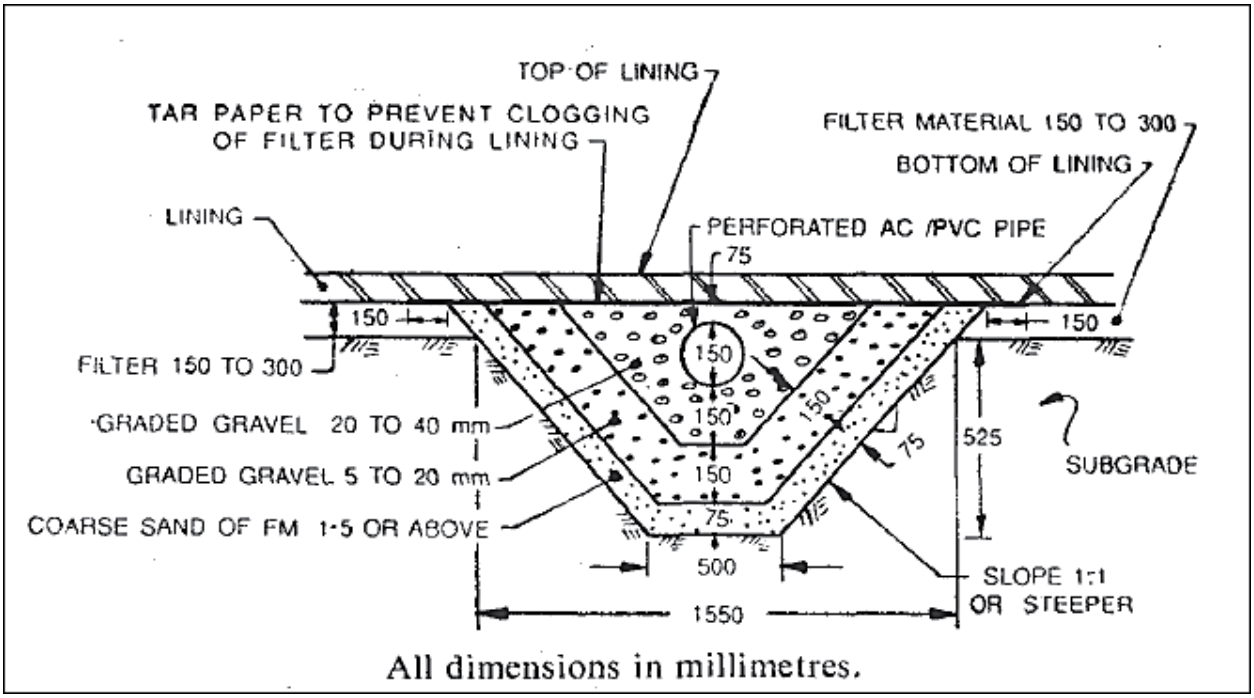

FIG. 1 TYPICAL SECTION OF LONGITUDANAL/TRANSVERSE DRAIN (PRESSURE RELIEF VALVE NOT SHOWN)

Spacing of transverse drains should depend on the size, location and efficiency of pressure relief valves. However, in general, transverse drains should be provided at 10 m interval.

Care should be taken that filter does not get clogged during the process of lining.

7 PRESSURE RELIEF VALVES (PRV)

7.1 Pressure relief valves should be provided on the longitudinal/transverse drains, if such drains are provided (*see* Fig. 2), and on slopes, if there are no transverse drains, the PRV may be provided in pockets filled with graded filter underneath the lining. Pockets may be square with sides of 600 mm or cylindrical with diameter 600 mm.

Pockets on slopes should be excavated with their sides at right angles to the slope. The perforated PVC housing pipe for the PRV should be 750 mm long for sides and 430 mm long for bed and

should conform to class-2 of IS 4985. It should be placed in the centre of the pocket. Graded filter as shown in Fig. 3 should then be carefully placed in the pocket and compacted to form even bedding for canal lining. Perforations in the housing pipe should be as shown in Fig. 4.

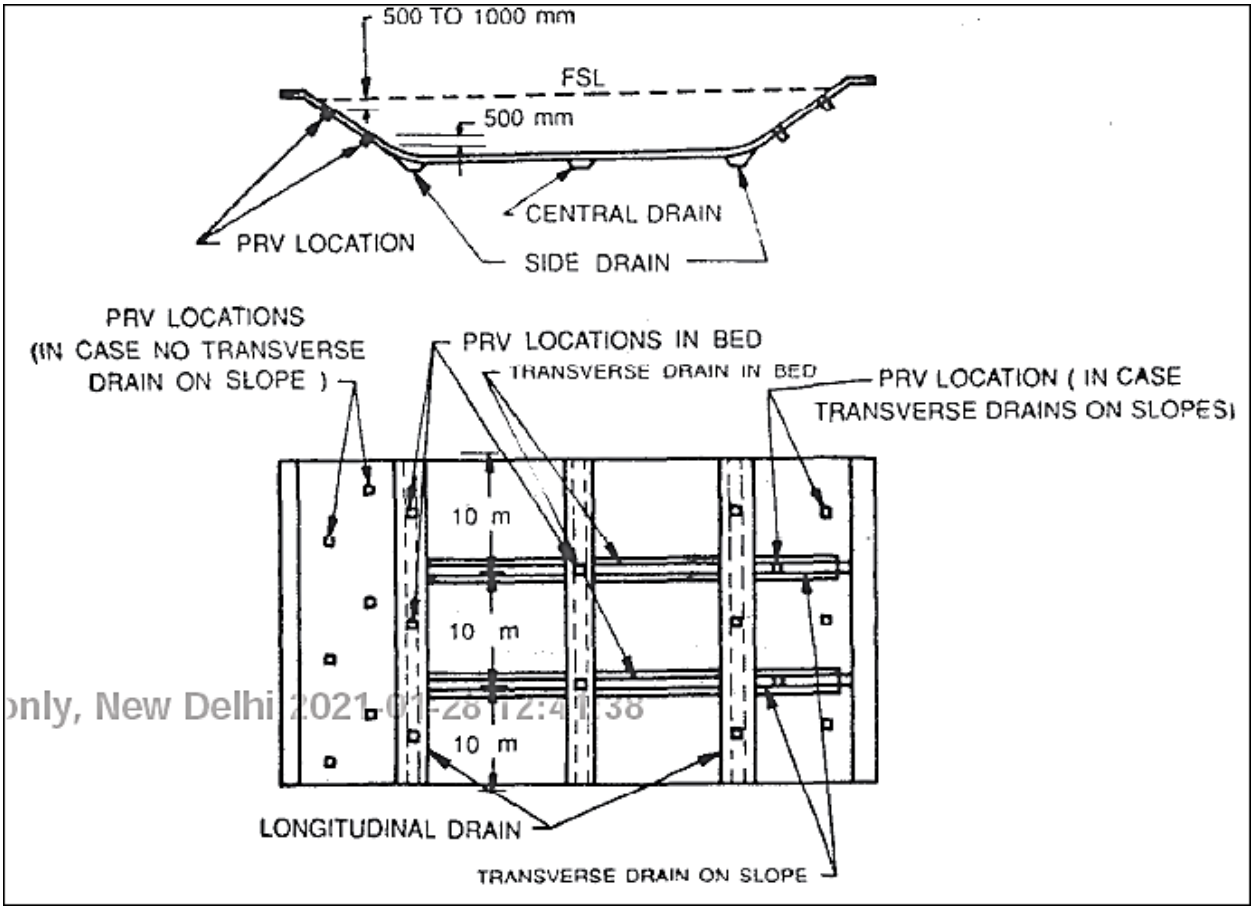

FIG. 2 ARRANGEMENT SHOWING DRAINS AND PRV LOCATIONS

7.2 Placing of PRV's

7.2.1 *Rows*

In general, one row at every 4 m should be provided on the sides. The first row should be about 50 cm above curve line and top row at 50 cm to 100 cm below full supply level. If the water depth is less than l.5 m, one row should be adequate. Valves in adjacent rows should be staggered.

7.2.2 *Spacing*

In general, one pressure relief valve for every 100 m^2 should be provided in the canal bed; while on the sides, one pressure relief valve for every 40 m^2 should be provided. However, the spacing should be decided on this general consideration, keeping in view the site conditions.

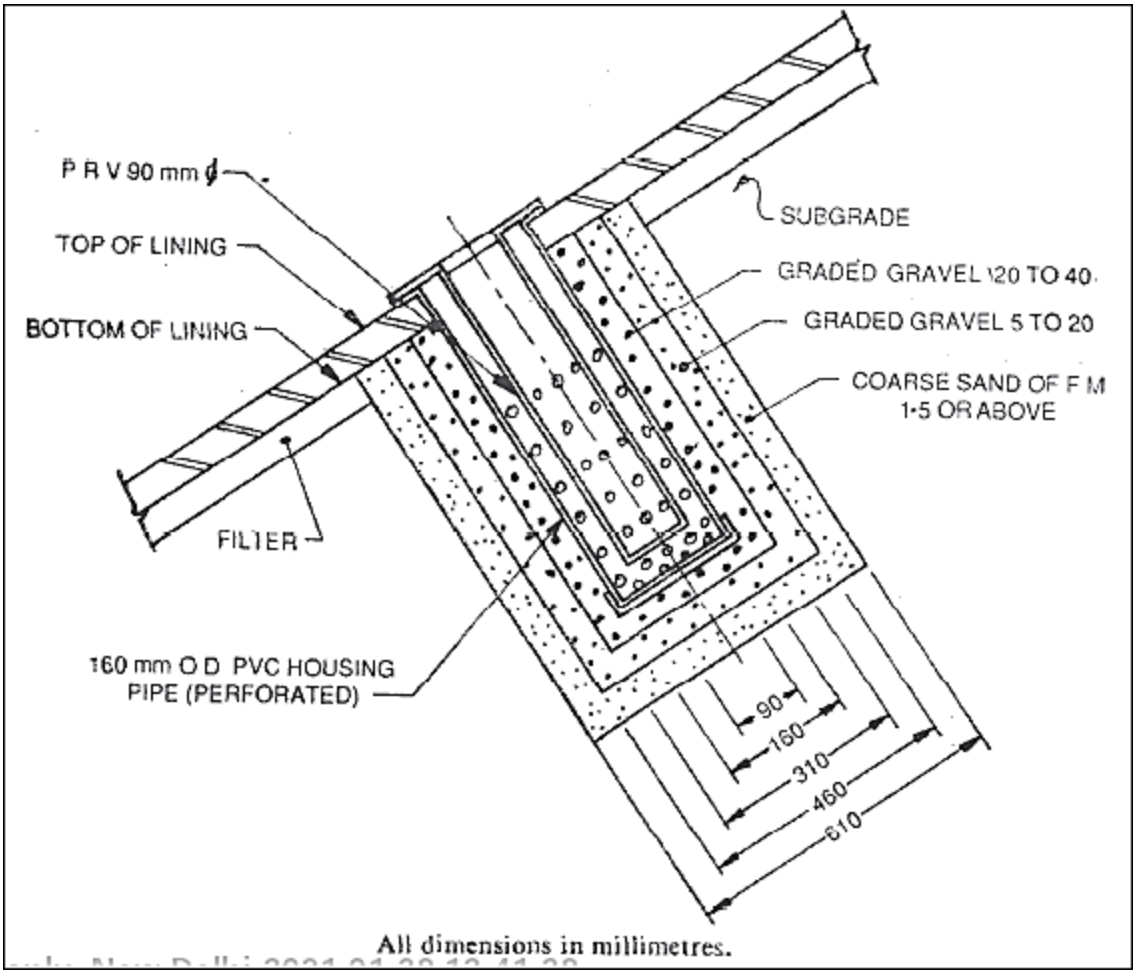

FIG. 3 PRV POCKET ON SLOPE

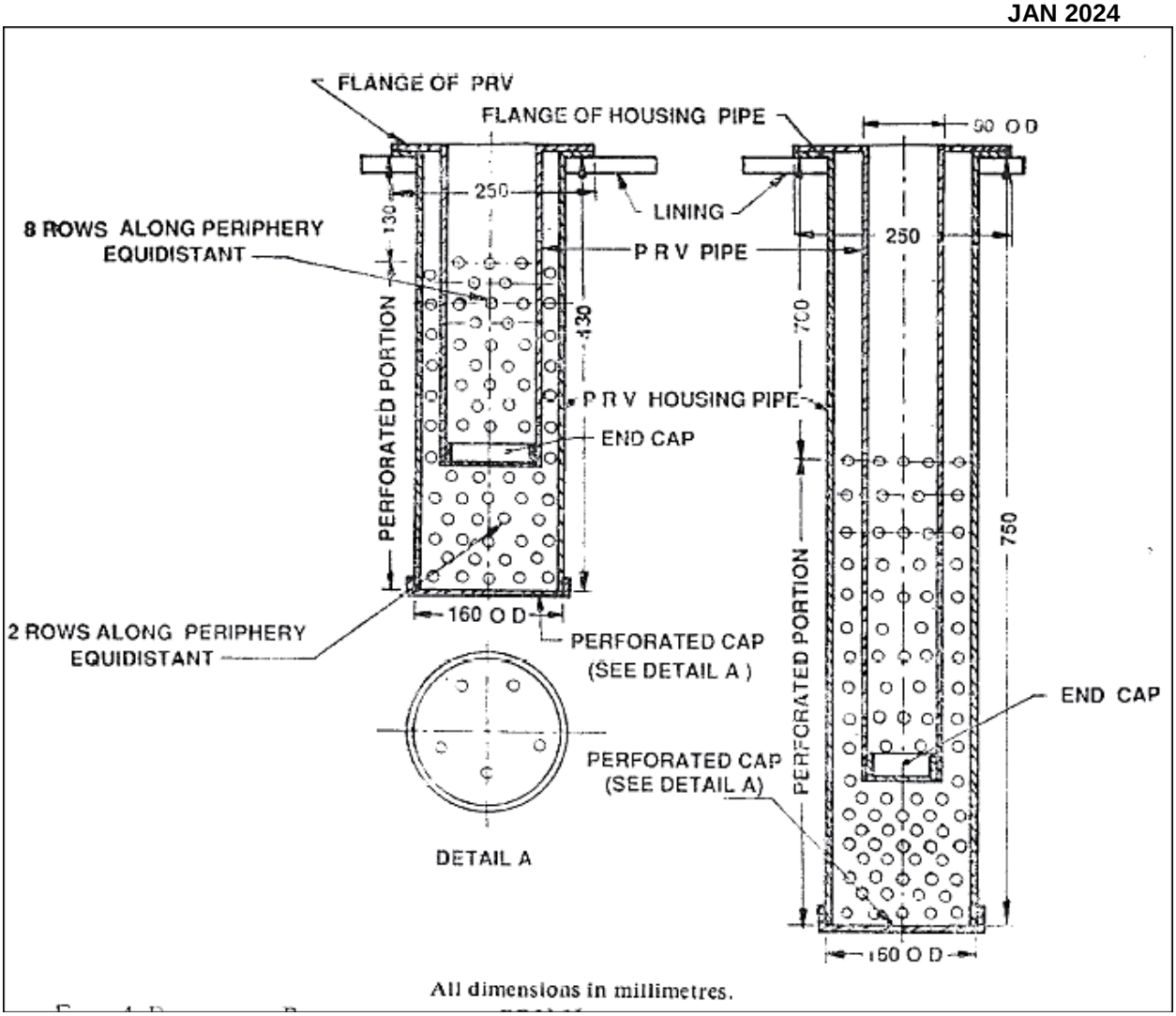

FIG. 4 DETAIL OF PERPORATION IN PRV HOUSING PIPE
(DETAIL OF PRV NOT SHOWN)