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Indian Standard

CODE OF PRACTICE FOR
PERMEABILITY TEST FOR MASONRY
DURING AND AFTER CONSTRUCTION

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(Continued on page 2)

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(Continued from page 1)

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0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 14 February 1985, after the draft finalized by the Dams (Overflow and Non-overflow) Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 Masonry is being adopted as a standard material of construction for low as well as high gravity dams. One of the important characteristics of a construction material for water retaining structures is impermeability.

0.3 It is the common practice to specify the strength requirements of mortar in masonry dams. In addition, an upper limit of permeability for mortar and masonry in masonry dams is required to be specified with a view to achieving a standard of workmanship.

0.4 Varying standards have been used for testing masonry in various masonry dams with regard to their permeability. Hence a need was felt for rationalizing a standard criterion for the same.

0.5 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 code gives guidelines for permeability tests for masonry during and after construction and the standards to be achieved.

*Rules for rounding off numerical values (*revised*).

2. DEFINITIONS

2.1 Coefficient of Permeability — The rate of flow of water under laminar flow conditions through a unit cross-sectional area of porous medium under a unit hydraulic gradient and at a standard temperature of 27°C.

2.2 Lugeons — It is the water loss in litres per minute per metre depth of the drill hole under a pressure of 10 atmospheres maintained for 10 minutes in a drill hole of 46 to 76 mm diameter.

3. PERMEABILITY TESTS

3.1 Frequency of Test

3.1.1 Masonry — Permeability test for the masonry shall be conducted regularly and at frequent intervals to judge quality and maintain uniformity. Every block, where fresh masonry is laid, shall be tested at least once every year.

3.1.2 Mortar — Permeability tests on mortar shall normally be carried out once in a week. Specimens 100 mm dia and 50 mm high or similar size prepared from mortar as used on work shall be used for testing.

3.2 Testing Procedure for Masonry — Test holes 76 mm in diameter and of appropriate depth (say 4 to 6 m) shall be drilled on the built up masonry after 28 days hardening. Drilling by rotary (diamond) drill shall be preferred in order to have the least disturbance of the masonry already constructed. The holes shall be kept 300 to 600 mm above the bottom level of the masonry to be tested. These holes shall be drilled vertically in two rows. One row shall be at 1.5 m from the axis of the dam. The second row shall be at about one-third of the width of the dam from the rear face excluding the front impervious face. The holes shall be provided staggered and it should be seen that at least one hole each in upstream and downstream portion in each block is provided. The holes may be closer if found necessary on the basis of the permeability test results. In locating the holes, position of any embedded parts, instruments, galleries and other opening shall be kept in view. The holes thus drilled shall be cleaned, filled with water and saturated for 48 hours. Then these holes shall be subjected to a water loss test to determine 'Lugeon' value. Notwithstanding the test pressures specified for lugeon values, the actual test pressures should not be so high as to cause disturbance to masonry. Then assuming linear variation of water loss with respect to the pressure applied, the water loss in lugeons may be interpreted. For details of procedure and test equipment reference may be made to IS : 5529 (Part 2)-1973*.

*Code of practice for *in-situ* permeability tests: Part 2 Test in bedrock.

3.2.1 When a concrete membrane is used on the upstream face of a masonry dam, the upstream hole for water loss test shall be drilled one meter downstream of the junction of concrete membrane with masonry.

3.2.2 After the water loss tests the holes shall be grouted to refusal with neat cement and the results of grout intake recorded.

3.3 Testing Procedure for Mortar — Permeability tests on mortar specimen shall be conducted in accordance with the procedure specified in IS : 1727-1967*.

4. STANDARDS OF IMPERMEABILITY

4.1 Masonry — Standard of impermeability aimed at shall be a water loss of not more than 2.5 and 5 lugeons in the upstream and downstream portions of the dam respectively.

4.1.1 Permissible water loss in holes drilled in accordance with **3.2.1** shall be not more than 2.5 or 5 lugeons depending on the mortar mix used for masonry at that location (rich or lean respectively).

4.1.2 The values of water loss obtained from the test is the overall value of masonry including loss into cracks joints, etc. It provides an approximate estimate of the possible leakage that may take place through specific zones of masonry.

4.2 Mortar — Mortar as used on work shall not give a coefficient of permeability greater than 2.5×10^{-8} mm/s for rich mortar and 4.8×10^{-8} mm/s for lean mortar.

5. FACTORS AFFECTING PERMEABILITY

5.1 Two factors affecting permeability of the masonry are:

- a) permeability of mortar itself; and
- b) workmanship, namely, whether voids between the stones are filled with mortar or left free.

5.2 Pointing in the upstream face reduces seepage through the dam.

6. REMEDIAL MEASURES

6.1 If the test results indicate water loss greater than specified values grouting should be done as a remedial measure. Grouting pressure should be kept such that it does not damage the constructed masonry.

*Methods of test for pozzolanic material (*first revision*).

INDIAN STANDARDS
ON
DAMS

IS:

- 6512-1984 **Criteria for design of solid gravity dams (*first revision*)**
- 6955-1973 **Code of practice for subsurface exploration for earth and rockfill dams**
- 7894-1975 **Code of practice for stability analysis of earth dams**
- 8237-1976 **Code of practice for protection of slope for reservoir embankments**
- 8414-1977 **Guidelines for design of under-seepage control measures for earth and rockfill dams**
- 8605-1977 **Code of practice for construction of masonry in dams**
- 8826-1978 **Guidelines for design of large earth and rockfill dams**
- 9296-1979 **Guidelines for inspection and maintenance of dams and appurtenant structures**
- 9297-1979 **Recommendations for lighting, ventilation and other facilities inside dams**
- 9429-1980 **Code of practice for drainage system for earth and rockfill dams**
- 10135-1982 **Code of practice for drainage system for gravity dams**
- 10635-1983 **Guidelines for free board requirement in embankment dams**