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भारतीय मानक

चिनाई बाँधों के प्रतिप्रवाह मोहरे का गनाइटीकरण – मार्गदर्शी सिद्धान्त

Indian Standard

GUNITING THE UPSTREAM FACE OF MASONRY DAMS — GUIDELINES

UDC 627·82·064·3

BUREAU OF INDIAN STANDARDS
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Price Group 2

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Dams (Overflow and Non-overflow) Sectional Committee had been approved by the River Valley Division Council.

Due to seepage problem through upstream face of masonry dams on account of poor workmanship, non-availability of skilled workers, etc, it has been felt of late to take certain additional measures to minimise this seepage and bring it down within permissible limits. The possible measures generally taken to minimise such seepage are: (1) upstream concrete mantle, (2) sandwitch concrete membrane, and (3) guniting upstream face. This standard covers only the guidelines for guniting upstream face of masonry dams to give necessary guidance in this respect.

Indian Standard

GUNITING THE UPSTREAM FACE OF MASONRY DAMS — GUIDELINES

1 SCOPE

This standard covers the general guidelines to be followed for guniting upstream face of masonry dams.

2 REFERENCE

The Indian Standards listed in Annex A are necessary adjuncts to this standard.

3 TERMINOLOGY

3.0 For the purpose of this standard, the following definition shall apply.

3.1 Gunite

Gunite is the mortar or concrete conveyed on to a surface by means of air pressure applied through a continuously feeding pressure vessel termed as 'gun'. In this process, the maximum size of aggregate is restricted to less than 10 mm.

4 MATERIALS

4.1 Cement

The cement used should be any of the following, depending upon site conditions:

a) Ordinary Portland cement conforming to IS 269 : 1982, IS 8112 : 1989 or IS 12269 : 1987;

b) Portland pozzolana cement conforming to IS 1489 (Parts 1 and 2) : 1991;

c) Portland slag cement conforming to IS 455 : 1989;

d) Supersulphated cement conforming to IS 6909 : 1990;

e) Rapid hardening Portland cement conforming to IS 8041 : 1990; and

f) Sulphate resisting Portland cement conforming of IS 12330 : 1988.

4.2 Sand

Sand for guniting should comply with the requirements given in IS 383 : 1970. Sand generally conforming to zone 2 or 3 grading should be specified but coarser sand may also be used. The actual grading should be decided at the site after making trial mixes. Finer sand would generally result in greater drying shrinkage and coarser sand would give more rebound.

Sand should not contain more than 2 percent dust below 0·2 mm as the dust tends to form a harmful coating on the aggregate particles. Moisture content of sand should not be greater than 5 percent, otherwise clogging of the hose and nozzle may occur.

4.3 Water

Water used for guniting should conform to the requirements specified in IS 456 : 1978.

4.4 Admixtures

Admixtures should be used only when so required. Admixtures when used should meet the requirements of IS 9103 : 1979.

Admixtures containing chlorides should not be used in gunite exposed to water containing sulphates or in gunite which is in contact with reinforcement.

Air-entraining admixtures should not be used unless they have additional waterproofing properties.

Soluble admixtures should be dissolved in water before being added to the mix. Insoluble admixtures should be mixed with cement before mixing cement with fine aggregate.

4.5 Wiremesh

Welded wire fabric used should conform to IS 1566 : 1982. For gunite more than 25 mm thickness, it would be preferable to use wiremesh.

5 SURFACE PREPARATION

5.1 The masonry surface where guniting is required to be done, should be made rough by chipping and raking out mortar joints. Chipping should be done by using chisels and hammers. After roughening the surface and raking of joints, the face should be cleaned and washed by air and water jets under pressure. It should be ascertained that no loose material, dirt or any other material is left on the face.

5.2 Before guniting, the masonry face should be kept clean and free from oil, dirt, etc, as this would prevent the gunite from forming bond with the surface.

5.3 Arrangements should be made for protecting adjacent surfaces which are not to be gunited, by using waterproof paper.

5.4 Adjoining face or bed which will be spoiled by guniting due to rebound, should also be protected, for example, intake struture, spillway pier, etc.

5.5 Absorption of water from the gunite to the underlying masonry is critical as this might result in cracking of the gunite. The surface to be gunited should be properly dampened.

6 FIXING OF WIREMESH

6.1 The wiremesh should be fixed to the masonry by means of wall plugs and nails placed about 750 mm apart. Adjacent sheets should be firmly tied together with wire at intervals not exceeding 200 mm. The mesh should be placed slightly away from the masonry (12 mm minimum) and should have minimum cover according to IS 456 : 1978. The minimum wiremesh spacing should be 50 mm × 50 mm and wiremesh should be lapped one and a half squares in all directions.

7 GUNITING

7.1 General

The gunite mix should normally consist of 1 part of cement to 3 parts of dry sand by mass and conforming to the requirements given in **14**. On vertical surface a thickness of 25 to 38 mm may normally be deposited in one operation; but, if the weather is wet, this may have to be reduced to 19 mm. For higher thickness, the gunite should be built up by successive applications, , the previous layer being allowed to set but not become hard before the application of subsequent layer. When successive layers are applied, they should be of the same mix proportions.

7.2 Mixing

7.2.1 The equipment used for guniting should conform to IS 6433 : 1972 and should be capable of discharging the sand-cement mixture into the delivery hose under close control and it should deliver a continuous smooth stream of uniformly mixed materials at the proper velocity to the nozzle. The discharge nozzle should be equipped with a manually operated water injection system for directing an even distribution of water through the sand-cement mixture. The water valve should be capable of ready adjustment to vary the quantity of water and should be convenient to the nozzle man.

7.2.2 The operating air pressure at the gun outlet should not be less than 0·24N/mm^2. The water pressure should be maintained uniform and be sufficient to ensure adequate hydration at all times. Hydration is considered to be adequate when the gunite exhibits a silky and glistening wet surface as it is placed. The water pressure should exceed the operating air pressure at the nozzle by at least 0·1 N/mm^2 so as to ensure that the water is intimately mixed with other materials. At the nozzle the water pressure is generally not less than 0·4 N/mm^2.

7.2.3 In case of wet sand, the moisture content is to be accounted for while designing the gunite mix.

7.3 Guniting Operation

7.3.1 Before starting the guniting operation, the surface should be prepared as described in **5**.

7.3.2 Shooting strips should be used to ensure proper thickness of gunite and to facilitate the forming of straight lines and sharp arrises.

7.3.3 The nozzle should be held in the optimum position for placement at all times. The nozzle should be held at a distance of 0·6 to 1·2 m from the receiving surface and at right angles to it.

7.3.4 All vertical surfaces should be worked from the bottom to the top.

7.3.5 All sand pockets should be cut out and made good during the course of guniting.

7.3.6 The first coat should be screeded with a sharp-edged trowel to bring the surface true to line and level. Subsequent coats should be shot onto a hardened wetted surface.

7.3.7 With the last mix of the day, the work is to be tapered off to a fine edge. This edge is to be wetted and cleaned with an air/water jet before being joined to the next day's work.

7.3.8 Badly deteriorated areas should be cut back to sound material and reinforced with light mesh fixed into the sound surface.

7.3.9 Corners, re-entrant surfaces and pockets should be filled first before guniting the surface.

7.3.10 Next layer of guniting should be allowed after the first layer is set. From this layer all loose materials, rebound, etc, should be removed by brooming, sand blasting or water jetting. Before the next layer is started, the surface should be thoroughly sounded by a hammer for hollow areas resulting from rebound pockets or lack of bond. Such areas should be cut out and replaced with the next layer.

7.3.11 The final coat, generally 3 to 6 mm thick, should be applied to the fresh, finished, screeded, lightly wetted surface of the gunite. The final coat should be a natrual nozzle finish.

7.3.12 The finished gunite should be completely protected from wind, draught, rain, sunlight and frost by suitable means.

8 AIR SUPPLY

Properly operating air compressor of ample capacity is essential for satisfactory operation. The compressor should be capable of maintaining a supply of clean and dry air adequate for maintaining sufficient nozzle velocity for all parts of work. Air hoses should be capable of withstanding at least twice the operating pressure.

9 WATER SUPPLY

Water is supplied to the valve fitted to the nozzle through a light, flexible, high pressure line. Wherever possible, this line should be connected directly to the main supply provided that this supply has pressure of not less than 0·4 N/mm^2.

10 REBOUND

Materials which rebound and drop down, should in no case be reused and should be immediately removed and disposed off. The guniting should be done in such a manner that waste of cement due to rebound is minimum.

11 SUSPENSION OF WORK

11.1 Guniting operation should be suspended in condition of likely exposure to high winds, freezing or rain.

11.2 At the end of each day's work or on stopping of work for any other reason, the gunited surface should be sloped to a thin edge and the work should be resumed after cleaning the surface (*see* **7.3.7**).

12 FINISHING

Natural gun finish is preferred. No further finishing should be carried out.

13 CURING

The finished gunite should be cured by continuous and uniform water sprays after a period of 8 h from placement and for a period of 7 days. The curing water should be of the same quality as that of the mixing water.

14 TEST REQUIREMENTS

14.1 Compressive Strength

14.1.1 The test should be carried out on gunite specimens at the age of 7 days or 28 days or both and value should conform to the specific requirements of the structures. The average value of three specimens should be considered.

14.1.2 It is generally not feasible or desirable to core the structure to obtain specimens for regular control tests. Therefore, small unreinforced test panels, at least of 30 cm square, so as to be large enough to obtain all the test specimens needed and also to indicate what quality and uniformity may be expected in the structure, should be periodically gunned, and cores extracted from them for tests. The thickness should be the same as in the structure except that it should normally be not less than 7·5 cm. The panels are fabricated by gunning on to a back form of plywood. A separate panel should be fabricated for each mix design being considered, and also for each gunning position to be encountered in the structure.

14.1.3 Test cores should, however, be taken from the structure as often as necessary to ensure that the control tests reflect the quality of material in the structure by correlating to the results from the tests made from panels (*see* **14.1.2**).

14.1.4 The cores for testing should have a minimum diameter of 7·5 cm and a length-diameter ratio of at least 1. The test should be done according to IS 516 : 1959.

14.2 Permeability Test

14.2.1 When tested according to the method described in **14.2.2**, 50 mm thick gunite specimens should show no water percolation up to 0·7N/mm^2 pressure.

14.2.2 The permeability test should be carried out on gunite specimens of 100 mm dia and 50 mm high using the equipment and the procedure specified in IS 1727 : 1967, with the following modifications:

a) Permeability test should be carried out using a final water pressure of 0·7N/mm^2.

b) The gunite samples should be drilled out from the upstream face of the masonry dam of preferable extracted from the gunited test panels, at least 30 cm square and 75 mm thick, cast during guniting operation.

c) The test should be conducted on 28-day old specimens.

d) For each test, three specimens should be tested at a time and the average for three samples should be reported as the permeability of the gunite.

ANNEX A

(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
269 : 1989	Specification for 33 grade ordinary Portland cement (*fourth revision*)
383 : 1970	Specification for coarse and fine aggregates from natural sources for concrete (*second revision*)
455 : 1989	Specification for Portland slag cement (*fourth revision*)
456 : 1978	Code of practice for plain and reinforced concrete (*third revision*)
1489 : 1991	Specification for Portland pozzolana cement:
(Part 1)	Part 1 Flyash based (*third revision*)
(Part 2)	Part 2 Calcined clay based (*third revision*)
1566 : 1982	Specification for hard-drawn steel wire fabric for concrete reinforcement (*second revision*)
6433 : 1972	Specification for guniting equipment
6909 : 1990	Specification for supersulphated cement
8041 : 1990	Specification for rapid hardening Portland cement (*first revision*)
8112 : 1989	Specification for 43 grade ordinary Portland cement (*first revision*)
9103 : 1979	Specification for admixtures for concrete
12269 : 1987	Specification for 53 grade ordinary Portland cement
12330 : 1988	Specification for sulphate resisting Portland cement

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