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Indian Standard

NO-FINES CAST *IN SITU* CEMENT CONCRETE — CODE OF PRACTICE

भारतीय मानक

स्थान पर बारीक कण रहित सीमेंट कंकरीट प्लाई — रीति संहिता

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FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards on 20 July 1989, after the draft finalized by the Building Construction Practices Sectional Committee had been approved by the Civil Engineering Division Council.

No-fines cement concrete has highly permeable mass with large air spaces. It is an agglomeration of coarse aggregate particles each surrounded by a coating of cement paste, up to about 1·25 mm thick. As the aggregates to be used is almost single sized which results in formation of enough voids and thus preserve its most important properties of light weight and eliminating rise of dampness. No-fines cement concrete can be used in foundation as well as in floors in place of lime concrete where elimination of rise of salt and moisture is desirable.

No-fines cement concrete has great potentiality as a substitute for brick masonry where good bricks are not available (specially in black cotton soil or hill zone). Further, the thermal conductivity of a wall made of no-fines concrete with conventional aggregates and a wall of solid brickwork of the same thickness is about the same. It may also be used in wall foundation concrete, concrete under floors and in damp proof course.

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

NO-FINES CAST *IN SITU* CEMENT CONCRETE — CODE OF PRACTICE

1 SCOPE

1.1 This code covers the preparation and laying of no-fines cast *in situ* cement concrete used for walls, foundations and eliminating rise of dampness.

2 REFERENCES

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

3 TERMINOLOGY

3.1 For the purpose of this standard, the definitions given in IS 4845 : 1968 and IS 6461 (Parts 1, 2, 5 to 10) shall generally apply in addition to the following.

3.2 Aggregate Cement Ratio

The ratio weight of coarse aggregate to weight of cement is called the aggregate cement ratio.

3.3 No-Fines Concrete

No-fines concrete is composed of coarse aggregate cement and water only.

4 MATERIALS

4.1 Cement

The cement used shall conform to IS 269 : 1976, IS 1489 : 1976 or IS 455 : 1976 and IS 8041 : 1978.

4.2 Aggregate

4.2.1 *General*

The aggregate consists of crushed stone aggregate, natural single or brick ballast from slightly over burnt bricks or brick bats. It should be homogeneous in texture and roughly cubical in shape. The aggregate to be used in the concrete should be uniformly of the same size. The aggregates should conform to IS 383 : 1970.

4.2.2 *Size of Aggregate*

The aggregate would be nominally graded from 40 mm or 20 mm. Whichever size is used, the proportions of oversized and undersized material must be kept as low as possible, generally oversize and undersize material should not be used more than 5 percent and 10 percent respectively.

NOTE — 10 mm aggregates may be used but it requires more quantity of cement.

4.2.3 *Brick Ballast*

No under burnt bricks or *JHAMA* bricks shall be used under any circumstances. The brick ballast should be broken preferably at site of work. After immersion in cold water for 24 hours, absorption shall not exceed twelve percent.

4.2.4 *Stone Ballast*

It should be hard strong, dense, curable, clean and of proper size and free from weather effects. Any skin and coating are likely to prevent proper adhesion of cement. Soft thin flaky alongated or laminated pieces shall be avoided. The flakiness index should not exceed 15 percent. Stone shall have no deleterious reaction.

4.3 Water

The water to be used for mixing and curing shall conform to **4.3** of IS 456 : 1978.

5. PRODUCTION AND CONTROL OF CONCRETE

5.1 Soaking

The brick ballast shall be well soaked in clean water for a period of at least six hours before cement is mixed. The brick ballast should be skin dry at the time of mixing. For stone ballast no soaking is necessary.

5.2 Quantity of Water

For a given aggregate cement ratio there is only one water cement ratio which gives the maximum strength of concrete. This is called optimum water cement ratio. Optimum water cement ratio for various mixes are given in Table 1. The proportions of cement to aggregate and water should be selected so that the aggregate particles in the fresh concrete are coated with cement and water paste; and the paste should adhere to the aggregate and the coated coarse aggregate particle should make point to point contact to ensure bonding of the particles to meet the compressive strength

Table 1 Strength of Various Mixes (Using Portland Cement)

(*Clauses* 5.2 *and* 5.4)

Sl No.	Maximum Size of Stone Ballast mm	Cement Concrete Mix by Volume	Optimum W/C Ratio	Expected Compressive Strength After 28 Days N/mm^2
1	20	1 : 8	0·40	5·5
2	20	1 : 9	0·42	4·9
3	20	1 : 10	0·45	3·5
4	20	1 : 12	0·48	3·5
5	40	1 : 10	0·48	3·5
6	40	1 : 12	0·50	2·6

NOTE — The values given in this table are only for guidance and shall be checked *in situ* with actual mix.

requirements without the interstices between the aggregate particles being blocked with cement paste.

5.2.1 The most appropriate proportions should be determined partly on the basis of experience and partly on the compressive strength. Unlike normal concrete the no-fines concrete is very sensitive with respect to water content and therefore the correct water content must be determined by trial mixes. The brick ballast being water absorbent, the effective water cement ratio is thus variable and not easy to determine. This may lead to excessively wet or dry mixes being used. For brick aggregate normally 33 percent water by weight of cement may be added to the saturated skin dry aggregate.

5.2.2 It is important to maintain water cement ratio constant at its correct value. To this end determination of moisture contents shall be made as frequently as possible.

5.3 Mixing

Mixing shall be done in mechanical mixers only. The mixer shall comply with IS 1791 : 1968.

With drum mixer it is advisable to pour some water into the drum before the dry material is added. Thereafter the measured quantity of aggregates (thoroughly soaked but skin dry in case of brick ballast only) and cement shall be poured in the drum of mixer while it is revolving. The remaining water shall be added slowly up to the required quantity and wet mixing of the batch shall be continued for at least one minute till a uniform mix is obtained.

NOTE — Handmixing may be permitted for small quantities.

5.4 Strength

5.4.1 The strength of various mixes using portland cement are given in Table 1.

6 FORM WORK

6.1 No-fines concrete practically do not impart hydrostatic pressure on side shutters and, therefore, shuttering required is lighter and economical as compared to common concrete. Formwork should be designed and should be either of wooden planking with or without steel sheet lining or of steel plates stiffened by steel angles. The formwork should be properly fixed and stiffened to avoid any chances of bulging. Formwork should have smooth and even surface and joints. It should not require cutting, fitting and nailing of timbers on the site, but should consist of standard and interchangeable units assembled by bolts or metal clips or other fixings which can be handled quickly by unskilled labour and reused many times without deterioration. The main purpose of these requirements is to obtain the speed of building, economy in form work, costs and ease of erection and removal by unskilled labour when concrete is poured *in-situ*. The completed form work shall be inspected and approved by engineer-in-charge before the work is started. The surfaces of timber shuttering that would come in contact with concrete shall be well set and coated with soap solution applied before concreting is done. Form work may normally be removed after three days.

7 TRANSPORTING, PLACING, COMPACTING, CURING, WORKMANSHIP

7.1 Transporting

Concrete shall be transported from the mixer to site of work by methods which will prevent seggregation or loss of any of the ingredients and maintaining the required workability. It must not be allowed to set and then be used with the addition of further water to give workability.

7.1.1 During hot or cold weather concrete shall be transported in deep containers. Other suitable methods to reduce the loss of water by

evaporation in hot weather and heat loss in cold weather may also be adopted.

7.2 Placing

7.2.1 The concrete should be poured in horizontal layers proceeding continuously around the building. Concrete should not be allowed to pile up at a slope in the form work while awaiting further deliveries since this practice results in a diagonal line of weakness.

While laying care should be taken that cement slurry does not separate out and all ballast is uniformly coated with a cement layer. The concrete should be placed as soon as possible after mixing.

NOTES

1 The minimum thickness of a structural load bearing wall of no-fines concrete shall be 230 mm.

2 Thickness of placing concrete in a wall should not exceed 500 mm.

7.3 Compaction

7.3.1 Vibrators shall not be used for compaction of no-fines concrete.

7.3.2 No-fines concrete is compacted by rod or gentle ramming.

7.3.3 No water shall be added during ramming. Ramming should be done by one or more lines of men arranged across the width of the concrete with a lateral space of not more than 0·5 meter. Square rammers shall be used for corners.

7.4 Curing

If curing is inadequate no fines cement concrete will loose its water contents resulting in incomplete hydration of cement which will cause disintegration of concrete.

Fresh concrete is extremely sensitive to intense sunshine and wind and must be protected by damp sheet covers and by spraying with ample water; spraying should not be started too early since it may wash off the cement from the surface. Spraying must be maintained for at least seven days.

7.5 Workmanship

7.5.0 The no-fines concrete should be used under the supervision of a qualified person. However precautions as given in **7.5.1** to **7.5.3** should be kept in view while using no-fines concrete.

7.5.1 *Construction Joints in Walls*

The bond between new and existing work in no-fines concrete is weaker than in normal concrete. For this reason the following precautions may be taken in case of joints in walls.

7.5.1.1 *Vertical joints*

Vertical or raking construction joints should not be permitted in this material except where expansion joints are to be formed. If vertical construction joints are permitted near an external angle of the building these will seriously weaken the surface structure.

7.5.1.2 *Horizontal joints*

There should be as few horizontal construction joints as possible, and in consequence lifts should be of full storey height.

In forming horizontal joints, the exposed face of the site concrete should be cleaned thoroughly, that is with a wire brush and treated with a neat cement slurry applied by means of a brush. The new concrete should be poured immediately. Care should be taken to ensure that voids are filled at the foot of lift particularly where joint ends.

7.5.2 *Expansion Joints in Walls*

Cracks due to shrinkage and setting can be eliminated by applying expansion joints at 35 m interval.

7.5.3 *Wall Ties*

Interaction between floors and walls is maintained by mild steel wall ties applied throughout the building.

Minimum dimensions for wall ties are given in Table 2.

Table 2 Wall Tie Sizes for No-Fines Concrete Walls

Length of Building m	Minimum Sizes of Two Reinforcing Bars mm
10	10
18	12
35	14

Wall ties are spread throughout the elevation and the cross and partition walls. Wall ties must not be interrupted by windows (such as stair case windows) extending over more than one floor level. The over-lapping of hook and spliced ties is 500 mm. Wall ties can be fixed to the reinforcement of adjacent floor or to lintel.

Cracks at opening can be eliminated by placing two 10 mm diameter mild steel bars under

window sills (*see* Fig. 1) so as to overlap both sides of window rebate by 500 mm. Concrete cover is kept as 50 mm minimum and in order to prevent corrosion and improve bond characteristics, the reinforcement must be treated with a thin layer of (about 3 mm thick) of cement slurry or paste. Wall ties with adequate stirrups are placed in curbs of suitable size whenever walls are of high strength no-fines concrete.

8 FIXINGS AND PROVISION FOR SERVICES

8.1 Fixings

It is impracticable to nail into no-fines concrete, and fixing blocks, lugs or metal anchor plates. Lighter fittings, pipes, shelves, etc, can be screwed or nailed to embedded wooden blocks having been fastened to shuttering before pouring into the concrete. The heavier fittings for example wash basins, etc, are usually bolted to embedded metal anchor plates and wooden blocks.

8.2 Provision for Services

Services should be planned in advance. All holes, chases, ducts and cavities for services should be formed by inserting suitable cores in the shuttering before casting the concrete. Cutting finished no-fines concrete for services should be avoided since it is likely to lead to extensive damage.

9 FINISHING

9.1 Plastering

No-fines concrete requires the application externally of a treatment to fulfil the dual purposes of forming a bassier to the penetration of rain as also of decoration. The internal surface requires plastering for presenting a smooth and even appearance. Both internal and external walls may be plastered. The internal walls and inside of walls may be plastered. The plastering is 10 to 12 mm thick and is done in two layers. The layer thickness and sand grading recommendations for plastering are given in Table 3.

Table 3 Thickness and Sand Grading of Plastering Mortar

	Layer	Thickness mm	Sand Grading mm
1	Pricked	2 to 3	0 to 3
2	Floating	5 to 8	0 to 1 or 0 to 2

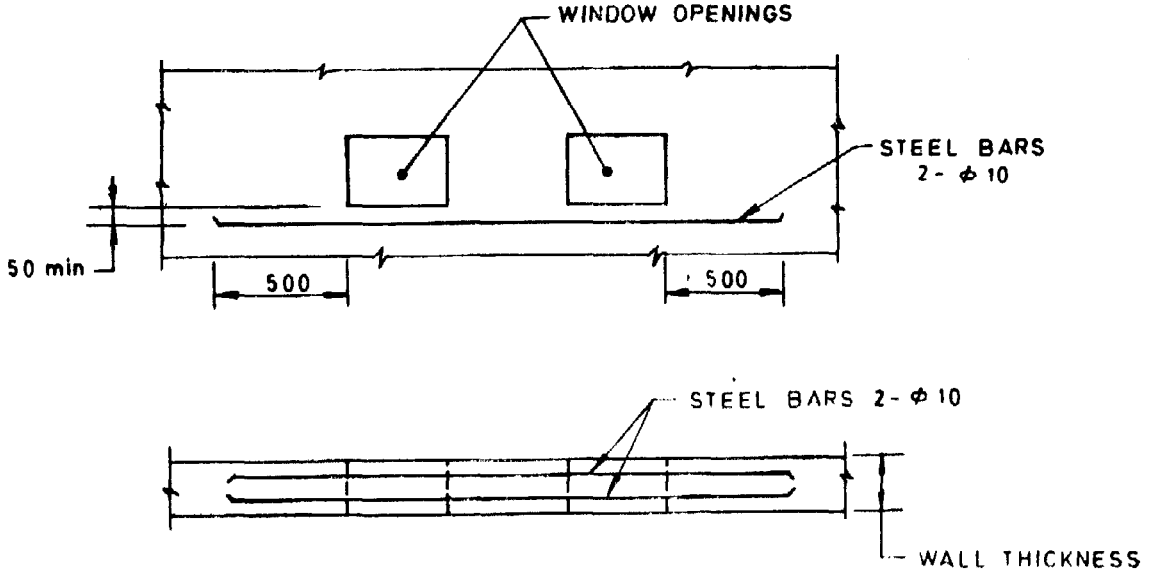
9.2 The composition of plastering mortor is given in Table 4.

Table 4 Composition of Plastering Mortar (by Loose Volume)

Layer	Composition		
	Cement	Lime	Sand
First	1	1·5	8 to 10
Second	0	1	3

10 PRECAUTIONS

10.0 The precautions as given in **10.1** to **10.3** especially for walling work should be observed.



All dimensions in millimetres.

FIG. 1 TYPICAL DETAILS OF REINFORCEMENT AT WINDOW OPENING

10.1 Provision of Weep Holes

Due to its very nature water does not penetrate no-fines concrete by capillary action. There is however, the danger of water entering the wall due to faulty detailing of windows and door opening or through cracks in rendering on account of use of cement rich mix for rendering. However water entering the wall through either of these faults will drain towards the foot of the wall where it flows away through deep holes. These must be provided above the damp proof course and kept clear of obstruction. Where lintels intervenes, these must be inclined over part of their surface downwards towards the out side face of the wall and the normal precautions of inserting a damp proof source must be taken, otherwise draining water is likely to be diverted to the inside of the wall. The damp and course should not be wholly sloped towards the outer face and at least two thirds of the area should from a level bearing.

10.2 Provision of Reinforcement

The drying shrinkage of no-fines concrete is about one half that of ordinary concrete containing similar coarse aggregate. Therefore the placing of these two concrete together should be avoided in order to check the cracking through differential shrinkage movements.

Since there is a concentration of stresses at the corners of the windows and door openings, these spots in no-fines concrete walls are after a source of weakness. Reinforcement may therefore be placed at wall openings. It may even be desirable to provide ordinary reinforced lintels over such openings. Wherever reinforcement is used, it should be coated with a thin layer of cement slurry to improve the bond strength and also to serve as means of protection against corrosion.

10.3 Concreting Under Special Conditions

Work in extreme weather conditions during hot or cold weather the concreting should be done as per the procedure set out in IS 7861 (Part 1) : 1971 or IS 7861 (Part 2) : 1981.

11 SAMPLING AND STRENGTH TEST OF CONCRETE

11.1 General

Sample from the fresh concrete shall be taken as per IS 1199 : 1959, which is placed and compacted in two equal layers. Each layer is tamped by ten blows of standard tamper (*see* Fig. 2). The mould shall be provided with a riser of 25 mm height to guide the tamper bearing plate. It shall consist of metal angles welded together to form a 150 mm square frame and shall be secured to the top of the mould by two screws threaded through lugs welded to two opposite sides of the frame. The riser of the mould shall then be removed and the surface of the concrete be trowelled to obtain a reasonably true face.

The cubes are cured at 90 percent relative humidity and at a temperature of 27 $\pm$ 2°C for 24 hours in the mould. Cubes shall be demoulded if sufficiently strong, otherwise kept in the mould for a further period of 24 hours. After demoulding, the cubes shall be marked for identification. They shall be immersed in water for just sufficient time to ensure that they are thoroughly wetted. After draining they shall be placed in a polythene bag which shall be sealed to prevent loss of moisture. They shall be stored at a temperature of 27 $\pm$ 2°C until time of testing. The cubes shall be tested as per IS 516 : 1959. If f_c is 28 day cube strength of no-fines concrete, the 7 days and 90 days strength shall be around 0·55 f_c and 1·15 f_c respectively. A deviation of $\pm$ 10 percent is permissible in these values.

11.2 Frequency of Sampling

It shall be in accordance with **14.2.1** and **14.2.2** of IS 456 : 1978 as applicable in case of plain and reinforced concrete.

11.3 Test Specimen

It shall conform to **14.3** of IS 456 : 1978 as applicable to plain and reinforced concrete.

11.4 Test Strength of Sample

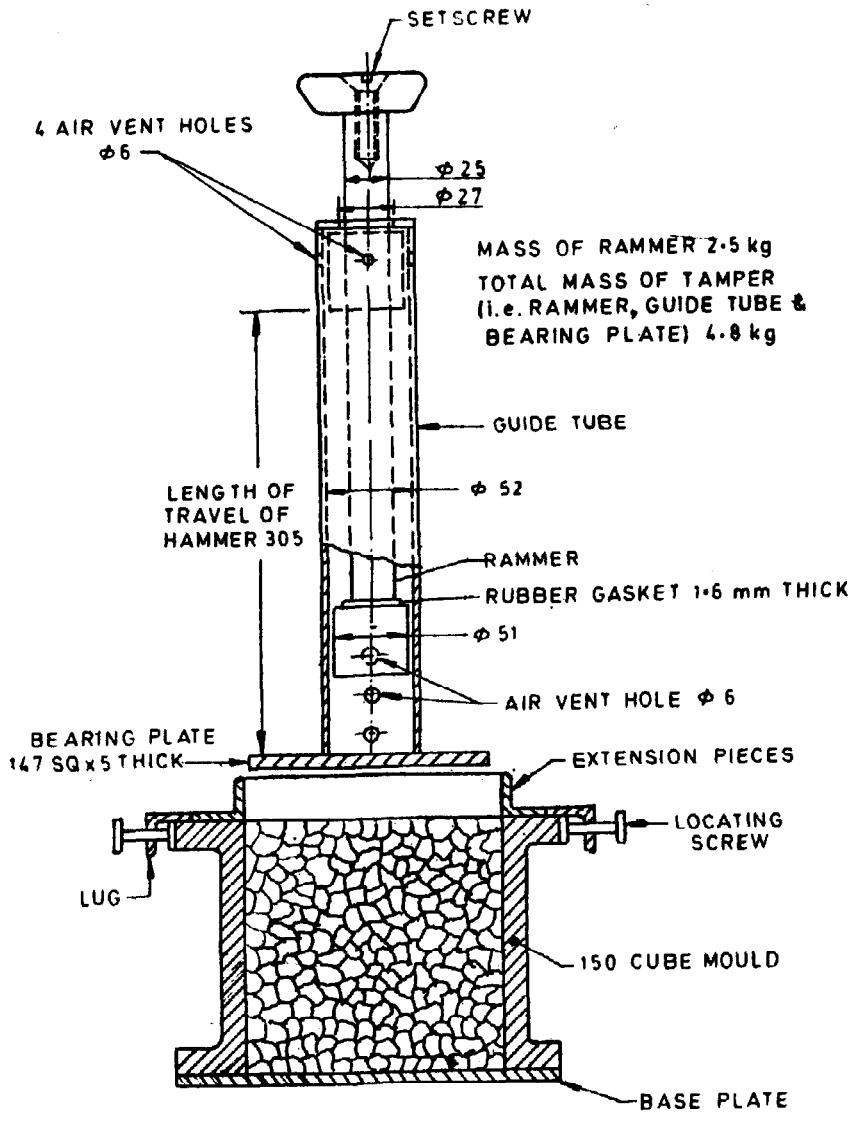
The test strength shall be average of the strength of three specimens.

11.5 Other Strength

The other strengths of the no-fines concrete depends upon its 28 days cube strength. These are approximately as follows:

Tensile strength	0·12 f_c
Flexural strength	0·23 f_c
Cylinder strength	0·61 f_c
Bond strength	0·19 f_c

Where f_c is 28 days cube strength. A variation of $\pm$ 10 percent is permissible in these values. No-fines concrete wall fails in compression at about half the cube strength of the concrete.



All dimensions in millimetres.

FIG. 2 TYPICAL APPARATUS FOR NO-FINES CONCRETE TEST CUBES

ANNEX A

(*Clause* 2.1)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*	*IS No.*	*Title*
269 : 1976	Specification for ordinary and low heat portland cement (*third revision*)	456 : 1978	Code of practice for plain and rainforced concrete (*third revision*)
		516 : 1959	Methods of test for strength of concrete
383 : 1970	Specification for coarse and fine aggregates from natural sources for concrete (*second revision*)	1199 : 1959	Methods of sampling and analysis of concrete
455 : 1976	Specification for portland slag cement (*third revision*)	1489 : 1976	Specification for portland pozzolana cement (*second revision*)

IS No.	*Title*
1791 : 1985	General requirements for batch type concrete mixers (*second revision*)
4845 : 1968	Definitions and terminology relating to hydraulic cement
6461	Glossary of terms relating to cement concrete
(Part 1) : 1972	Concrete aggregates
(Part 2) : 1972	Materials (other than cement and aggregates)
(Part 5) : 1972	Formwork for concrete
(Part 6) : 1972	Equipment, tools and plant
(Part 7) : 1972	Mixing, laying, compaction, curing and other construction aspects
(Part 8) : 1973	Properties of concrete
(Part 9) : 1972	Structural aspects
(Part 10) : 1973	Tests and testing apparatus
7861	Code of practice for extreme weather concreting
(Part 1) : 1971	Recomemnded practice for hot weather concreting
(Part 2) : 1981	Recommended practice for cold weather concreting
8041 : 1978	Rapid hardening portland cement (*first revision*)

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