IS 2571 (1970): Code of practice for laying in-situ cement concrete flooring [CED 5: Flooring, Wall Finishing and Roofing]

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Indian Standard

CODE OF PRACTICE FOR LAYING *IN-SITU* CEMENT CONCRETE FLOORING

(First Revision)

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

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Indian Standard

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(First Revision)

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Indian Standard

CODE OF PRACTICE FOR LAYING *IN-SITU* CEMENT CONCRETE FLOORING

(First Revision)

0. FOREWORD

0.1 This Indian Standard (First Revision) was adopted by the Indian Standards Institution on 19 December 1970, after the draft finalized by the Flooring and Plastering Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 *In-situ* cement cencrete flooring consists essentially of rich cement concrete, and possesses good wearing properties and facility of easy cleaning and maintenance which make it suitable for use in houses, offices, schools, hospitals and light industrial buildings. Depending upon the amount of loading and the degree of wear resistance needed, the floor finish has to be laid in various thicknesses and a careful selection has to be made regarding mix proportions, panel sizes and number of layers. Also the laying operations have to ensure the proper bonding of the finish to the base or sub-floor. This code provides necessary guidance in the selection of materials and laying and finishing of cement concrete flooring for obtaining satisfactory performance. This standard which was first published in 1963 is now being revised taking into account the experience gained in the concrete flooring work for the past few years.

0.3 In the formulation of this standard due weightage has been given to international co-ordination among the standards and practices prevailing in different countries in addition to relating it to the practices in the field in this country. This has been met by deriving assistance from B. S. CP204 : 1965 *In-situ* floor finishes, issued by the British Standards Institution.

0.4 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*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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

1. SCOPE

1.1 This standard covers laying and finishing of *in-situ* cement concrete flooring for non-industrial and light industrial buildings. Heavy duty floors and acid and alkali resisting floor finishes are not dealt with in this standard.

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definitions shall apply.

2.1 General Terms

2.1.1 *Base Concrete* — The layer of concrete on which the cement concrete topping is laid.

2.1.2 *Laitance* — A thin layer, consisting essentially of fine cement particles, which often forms a scum on the surface of freshly laid concrete. This layer may be formed by excessive surface trowelling of concrete immediately after it has been laid.

2.1.3 *Sub-base* — The prepared surface on ground on which base concrete is laid.

2.1.4 *Sub-floors* — The prepared surface of structural/suspended floor on which the floor finish is laid.

2.2 Tools and Accessories

2.2.1 *Screed Strips* — Temporary narrow strips of wood or steel laid on the sub-base or base concrete or sub-floor to act as guides for dividing the area to be paved into panels.

2.2.2 *Screeding Board* — A straight-edged wooden scantling used for floating a plane surface. It is moved with a sawing action, the two ends (if necessary) resting on screed strips or guides set at the correct height.

2.3 Site Operations

2.3.1 *Screeding* — Bringing the floor to a true and even surface by means of screeding board.

3. NECESSARY INFORMATION

3.1 For the efficient planning and execution of the work, detailed information with regard to the following is necessary:

a) Purpose for which the floor is to be used;

b) Floor area to be covered;

c) Location and size of openings and ducts, drainage outlets, if any, to be left out;

d) Details of the sub-base or sub-floor;

e) Type of soil in the sub-base and any seepage problem;

f) Specific requirements, if any, regarding the colour and appearance of the finished surface and of aggregates to be used;

g) Whether skirtings are required; and

h) Slope to be provided in the floor finish.

3.2 All the information stated in **3.1** shall be made available by the appropriate authority responsible for the construction of the whole building to those who are entrusted with the work of laying cement concrete floor finish before the work is started. Necessary drawings and instructions for preparatory work shall also be given where required.

3.3 Arrangements shall also be made for the proper exchange of information between those engaged in laying the floor finish and all others whose work will affect or will be affected.

4. MATERIALS

4.1 Cement — Cement used for the floor finish work shall conform to IS : 269-1967* or to IS : 455-1967† or IS : 1489-1967‡.

4.2 Aggregates

4.2.1 Aggregates for cement concrete flooring mix shall conform to the requirements of IS : 383-1963§. The aggregate crushing value, when determined in accordance with IS : 2386 (Part IV)-1963‖ shall not exceed 30 percent.

4.2.1.1 *Coarse aggregate* — The grading of graded coarse aggregate for cement concrete flooring mix shall be within the limits given in Table 1. The coarse aggregate shall generally be of the following sizes:

a) Base concrete (lean cement concrete or lime concrete)	Graded from 40 mm and below
b) Cement concrete topping of thickness 40 mm and above	Graded from 16 mm and below
c) Cement concrete topping of thickness 25 mm	Graded from 12·5 mm and below

*Specification for ordinary, rapid-hardening and low heat portland cement (*revised*).

†Specification for portland blast-furnace slag cement (*second revision*).

‡Specification for portland pozzolana cement (*revised*).

§Specification for coarse and fine aggregates from natural sources for concrete (*revised*). (Second revision in 1970).

‖Methods of test for aggregates for concrete : Part IV Mechanical properties.

d) Under-layer of cement concrete topping in two layers	Graded from 12·5 mm and below

TABLE 1 COARSE AGGREGATE

(*Clause* 4.2.1.1)

IS Sieve Designation	Percentage Passing for Graded Aggregate of Nominal Size			
mm	40 mm	20 mm	16 mm	12·5 mm
40	95 to 100	100	—	—
20	30 to 70	95 to 100	100	100
16	—	—	90 to 100	—
12·5	—	—	—	90 to 100
10	10 to 35	25 to 55	30 to 70	40 to 85
4·75	0 to 5	0 to 10	0 to 10	0 to 10
2·36	—	—	—	—

4.2.1.2 *Fine aggregate* — The grading of fine aggregate for cement concrete flooring mix shall be within the limits of one of the two zones given in Table 2. The fine aggregate shall be described as fine aggregate of the grading zone into which it falls.

TABLE 2 FINE AGGREGATE

IS Sieve Designation	Percentage by Weight Passing IS Sieves	
mm	Grading Zone 1	Grading Zone 2
10	100	100
4·75	90-100	90-100
2·36	60-95	75-100
1·18	30-70	55-90
600-micron	15-34	35-59
300-micron	5-20	8-30
150-micron	0-10	0-10

4.3 Water — Water used shall be clean and free from oil, acid, alkali, organic or vegetable matter. Generally potable water will be suitable. In case of doubt the quality of water should be analysed to ascertain conformity with **4.3** of IS : 456-1964*.

*Code of practice for plain and reinforced concrete (*second revision*).

5. DESIGN CONSIDERATIONS

5.1 Types of Floor Finish and Thicknesses — The floor finish shall be laid according to any of the specifications given in Table 3, depending upon the expected load and wear on the floor and the fact whether the topping is to be laid monolithic with the base or separately on a set and hardened base. In either case special precautions are necessary to ensure good bond between the topping and the base.

5.1.1 *Monolithic Floor Finish* (*Finish Types I and IV*) — In case of monolithic construction even a small thickness of topping is sufficient because of strength imparted to it by the base concrete and such type of finish is quite suitable as a moderately strong and economical floor finish (finish Type I) with good wearing quality.

5.1.1.1 On structural/suspended slabs, monolithic construction of floor finish (finish Type IV) is fundamentally more reliable form of construction from the point of view of bond development and consequently better wearing properties but this type of construction presents difficulties in construction if a close surface tolerance is to be obtained; it is difficult to obtain proper levels in the smaller thickness of topping. Moreover as the finish in such type of construction will be completed much in advance of the remaining building work it is likely to be damaged or discoloured due to subsequent building operations; this can, however, be avoided to some extent by covering the finished surface with a 75 mm thick layer of sand which can be removed after all the building operations are over and floor is ready to be used. Further when the surface of monolithic topping is damaged, its repairs cause difficulties as there is a risk of either the structural slab being weakened while picking up the surface for repairs, or the level of floor is likely to be raised to accommodate extra thickness required while repairing the surface with a fresh non-monolithic topping. Another disadvantage in this type of construction from practical point of view is that the time available on any day to the workmen for laying the finish monolithic with the structural slab is very much restricted. The advantage of monolithic topping is that the thickness required is less than in case of bonded finish thus reducing the materials and the load on the structure and the cost. This type of flooring can form a durable and economical floor finish provided the limitations given above are taken into account and suitably provided for.

5.1.2 *Bonded Floor Finish* (*Finish Types II, III, V and VI*) — In the case of bonded construction where floor finish is laid separately over a set and hardened base, the topping has to be laid to a greater thickness and the methods of laying have to be adjusted in such a way as to produce good bond between the topping and the base, failing which the difference in composition between the base and the topping and the change in temperature and moisture content will cause cracking, curling and

warping of the floor finish. The bond between the topping and the base in this type of construction can never be as perfect as in the case of monolithic construction and there may be slight lifting of floor finish at corners of different panels. In case of bonded floor finish laid on structural slabs, the greater thickness of topping also adds to the weight of the structure.

5.1.2.1 The advantage of this type of construction is that, as the base concrete or structural floor is laid much in advance and topping is laid after all the building operations are over, there is no danger of surface of the floor finish being damaged or discoloured due to other building operations. Where this type of finish is laid on structural slabs a very close surface tolerance can be obtained and there is no difficulty in obtaining proper levels and gradients in the finished floor surface because of greater thickness of topping. This type of finish is also suitable where floor finish is to be laid on old concrete or for repairing old floor finishes.

5.1.2.2 Where very dense and smooth surface is desired, the topping in this type of finish can be laid in two layers (finish Types III and VI). The under-layer consisting of a leaner mix is first laid separately on hardened base and the wearing layer of very stiff and richer mix, but of the thickness smaller than that of the under-layer is bonded to the green concrete of under-layer and finished smooth.

5.1.3 In case of bonded finish on structural slabs where it is not possible to obtain proper levels within the thickness of topping, a cushioning layer of about 50 to 75 mm thick lime concrete is laid and well compacted over the structural slab. Lime concrete layer may also be necessary to obtain a level surface over structural floors other than that of concrete or for embedding fixtures like pipes, etc. This will, however, add to the dead weight of the structure.

5.2 Mix Proportions — Mix proportions for the base concrete and the topping for different types of floor finish shall be as specified in Table 3.

NOTE — So far the practice had been to use 1 : 2 : 4 cement concrete for topping for bonded finish, but this mix is being increasingly replaced these days by 1 : 2½ : 3½ mix because it gives much better workability and finish.

5.3 Durability — Concrete floors possess good durability and resistance to abrasion and wear depending upon the following factors:

a) Choice of aggregate	Hard tough aggregate is essential for good durability as well as abrasion resistance.
b) Water-cement ratio	Provided the flooring is fully compacted, the lower the water-cement ratio the greater the durability and wear resistance; a lower water-cement ratio compatible with workability is, therefore, essential.

c) Density of flooring	Durability is increased in accordance with the degree of density of finish, consequently the flooring shall be well compacted. The staining on the floor surface that may result from absorption of oils is reduced by increasing the density of floor finish.
d) Curing	Adequate curing is very essential to ensure good wear resistance.

5.4 Resistance to Attack by Chemical Reagents — Concrete flooring is slowly attacked by acids, vegetable oils, fats, sugar solutions and various other agents; prolonged exposure to these reagents will bring about gradual deterioration.

5.5 Slipperiness — The slipperiness of concrete flooring depends mainly upon the surface treatment; when highly polished this type of floor finish is likely to be slippery. A trowel-finished floor is reasonably non-slip. Non-slip surfaces may be obtained by trowelling the floor surface or by providing non-slip inserts.

5.5.1 Floor finish over ramps, stairs and other similar situations, specially if they are liable to get wet, shall be finished in chequered pattern to make them non-slip.

5.6 Surface Hardening Solutions — It is not necessary, generally, to apply any further treatment to the cement concrete floor topping but dusting may be reduced by the application of one of the surface hardening solutions of sodium silicate, magnesium silico-fluoride or zinc silico-fluoride or proprietary materials consisting mainly of one or more of these compounds. These treatments are likely to need renewal at intervals of one year. Where proprietary materials are to be used, advice should be obtained from the manufacturers. The treatment may be given as described in Appendix A.

5.7 Size of Panels — Floor finish shall be divided into suitable panels so as to reduce the risk of cracking. Size of the panel is governed by the thickness of floor finish, the type of construction (monolithic or bonded construction), local conditions of temperature, humidity and the season in which flooring is laid. For floor finish laid in exposed situations or in hot and dry climates, the size of the panels shall be smaller as compared to the floor finish laid in less exposed situations or in cold and humid climates; the size of panels for integral floor finish can be larger than that of floor finish laid separately on the hardened base. Generally, no dimension of a panel shall exceed 4 m in case of floor finish laid monolithically with the base concrete and 2 m in case of floor finish laid separately on a hardened base; length of a panel shall not exceed 1½ times its breadth.

TABLE 3 RECOMMENDED SPECIFICATIONS FOR DIFFERENT TYPES OF CEMENT CONCRETE FLOOR FINISHES

(*Clauses* 5.1, 5.2, 5.9, 8.1, 8.2, 8.2.4, 9.1, 9.2 *and* 9.3)

TYPE	SUB-BASE	BASE CONCRETE		TOPPING		REMARKS
		Minimum Thickness mm	Mix Proportion	Minimum Thickness mm	Mix Proportion	
(1)	(2)	(3)	(4)	(5)	(6)	(7)
		A. Concrete Flooring Laid Over Ground				
I	Thoroughly consolidated ground covered with 100 to 150 mm well rammed (preferably coarse) sand	100	Cement concrete 1 : 4 : 8 (cement : fine aggregate : coarse stone aggregate of 40 mm and below by volume)	20	Cement concrete 1 : 2 to 3 (cement : stone aggregate of size 4·75 mm and below by volume)	*See* Fig. 1A. Cement concrete topping shall be laid monolithic with the base concrete (*see also* **5.1.1** and **8.1**)
IA	100 mm thick hard core of well consolidated dry brick or stone aggregate blinded with *MOORUM* (disintegrated rock) or coarse sand, laid over well rammed sand filling of 100 mm thick	100	do	25	Cement concrete 1 : 2 : 4 (cement : fine aggregate : coarse stone aggregate of size 12·5 mm and below by volume)	In places such as garrages where wheeled traffic comes into contact with the flooring the sub-base shall have a hard core over the well rammed sand filling. The cement concrete topping shall be laid monolithic with the base concrete (*see* Fig. 1B)
IB	Stone ballast (40 mm graded aggregates) mixed with locally available yellow or red soil or soft *MOORUM* in 1 : 1 proportion shall be compacted to about 300 mm thickness and thoroughly saturated	100	do	20	Cement concrete 1 : 2 to 3 (cement : stone aggregate of size 4·75 mm and below by volume)	In the regions having expansive soils like the black cotton soil the sub-base shall be laid as described (*see* Note). The topping shall be laid monolithic with the base concrete (*see* Fig. 1C)

	with water. This surface should be further covered with another 200 mm thick layer of soft *MOORUM* or cinder or sand and compacted properly before laying the base concrete					
II	Thoroughly consolidated ground covered with 100 to 150 mm well rammed (preferably coarse) sand	100	Cement concrete 1 : 5 : 10 (cement : fine aggregate : coarse stone aggregate of size 40 mm and below by volume), or lime concrete	25	Cement concrete 1 : 2½ : 3½ (cement : fine aggregate : coarse stone aggregate of size 12·5 mm and below by volume)	*See* Fig. 2A. Topping shall be laid separately over specially prepared surface of set and hardened base concrete (*see also* 5.1.2 and 8.2)
III	do	100	do	Under-layer-25	Under-layer-cement concrete 1 : 3 : 6 (cement : fine aggregate : coarse stone aggregate of size 12·5 mm and below by volume)	*See* Fig. 2B. Underlayer shall be laid separately over specially prepared surface of set and hardened base concrete. Wearing layer shall then be laid over the green surface of underlayer and finished monolithic with it (*see also* 5.1.2 and 8.2.4)
				Wearing layer-15	Wearing layer-cement concrete 1 : 2 to 3 (cement : stone aggregate of size 4·75 mm and below by volume)	

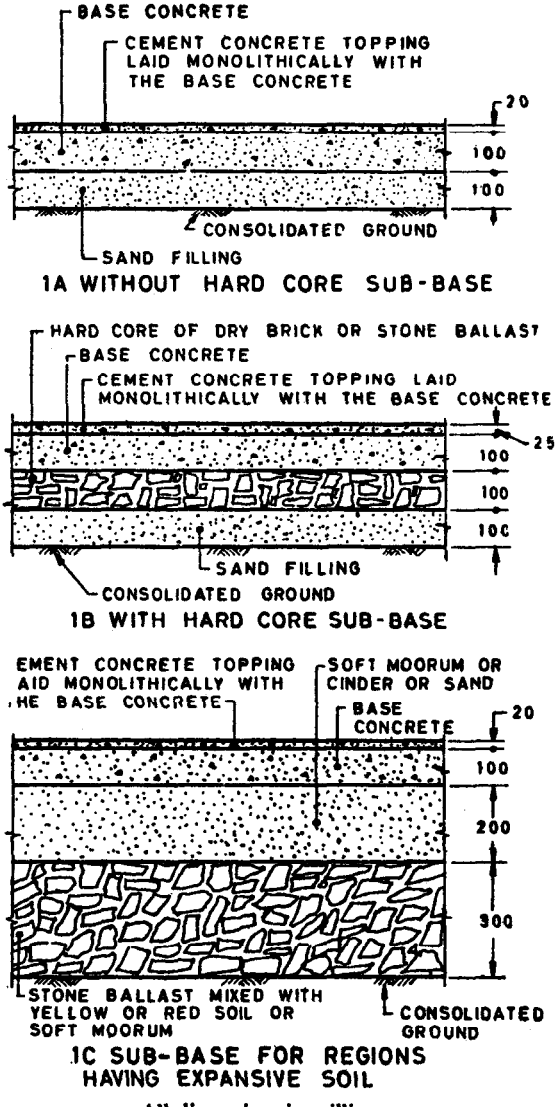
NOTE — In regions having expansive soils, the sub-base shall be laid as given in Type IB for both Type II and Type III flooring.

(Continued)

TABLE 3 RECOMMENDED SPECIFICATIONS FOR DIFFERENT TYPES OF CEMENT CONCRETE FLOOR FINISHES — *Contd*

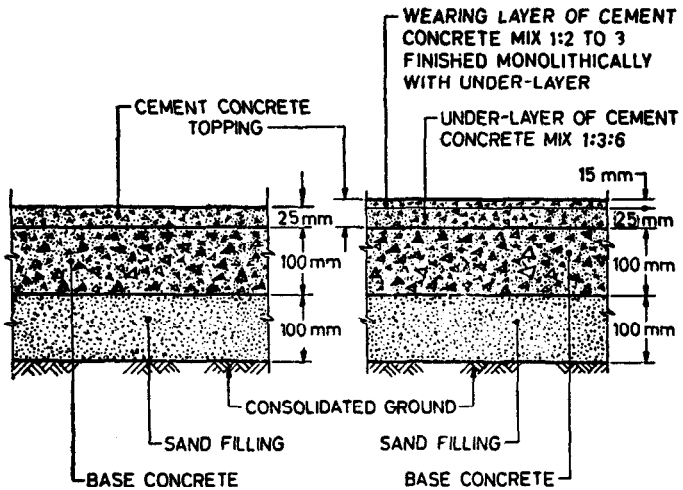
TYPE	SUB-BASE	BASE CONCRETE		TOPPING		REMARKS
		Minimum Thickness mm	Mix Proportion	Minimum Thickness mm	Mix Proportion	
(1)	(2)	(3)	(4)	(5)	(6)	(7)
		B. Floor Topping Laid Over Structural/Suspended Slabs				
IV	—	—	—	15	Cement concrete 1 : 2 to 3 (cement : stone aggregate of size 4·75 mm and below by volume)	*See* Fig. 3. Cement concrete topping shall be laid and finished monolithic with the structural slab. For this purpose the topping shall be laid immediately after the structural concrete has stiffened enough (but is still green) to allow for the workmen to tread over it by placing planks (*see also* **5.1.1** and **9.1**)
V	—	—	—	25	Cement concrete 1 : $2\frac{1}{2}$: $3\frac{1}{2}$ (cement : fine aggregate : coarse stone aggregate of size 12·5 mm and below by volume)	*See* Fig. 4A. Topping shall be laid directly over the specially prepared surface of set and hardened structural slab (*see also* **5.1.2** and **9.2**)

VI	—	—	—	Under-layer-25	Under-layer-cement concrete 1:3:6 (cement : fine aggregate : coarse stone aggregate of size 12·5 mm and below by volume)	*See* Fig. 4B. Under-layer shall be laid directly over the specially prepared surface of set and hardened structural slab. Wearing layer shall then be laid over the green surface of under-layer and finished monolithic with it (*see also* **5.1.2** and **9.2**)
				Wearing layer-15	Wearing layer-cement concrete 1:2 to 3 (cement : stone aggregate of size 4·75 mm and below by volume)	
VII	—	50 to 75	Lime concrete	Same as for V or VI		*See* Fig. 5. Cushioning layer of lime concrete shall be laid over the prepared surface of structural/suspended slab. Cement concrete topping shall be laid as for V or VI (*see also* **5.1.3** and **9.3**). Lime concrete shall be prepared and laid as per relevant requirements of IS : 2541-1965 'Code of practice for use of lime concrete in buildings'



All dimensions in millimetres.

FIG. 1 MONOLITHIC FLOOR FINISH (OVER GROUND)



2A Topping Laid in Single Layer 2B Topping Laid in Two Layers

FIG. 2 BONDED FLOOR FINISH OVER GROUND

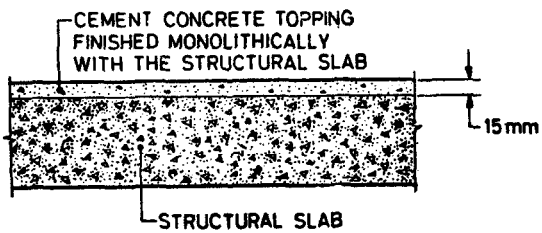
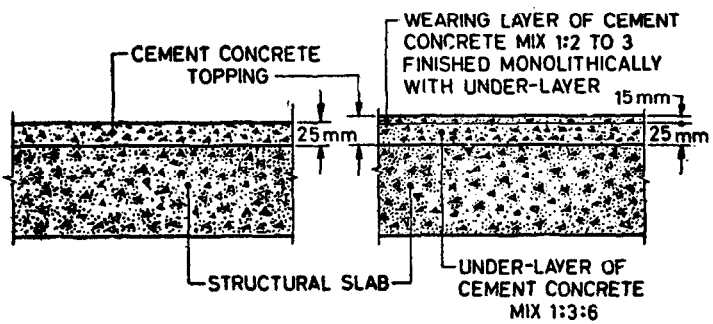
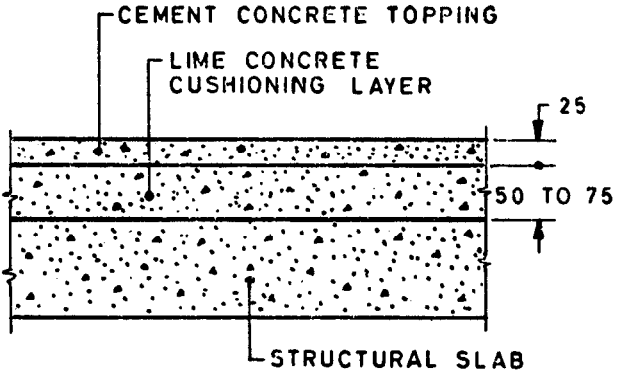


FIG. 3 FLOOR FINISH LAID MONOLITHICALLY WITH THE STRUCTURAL SLAB

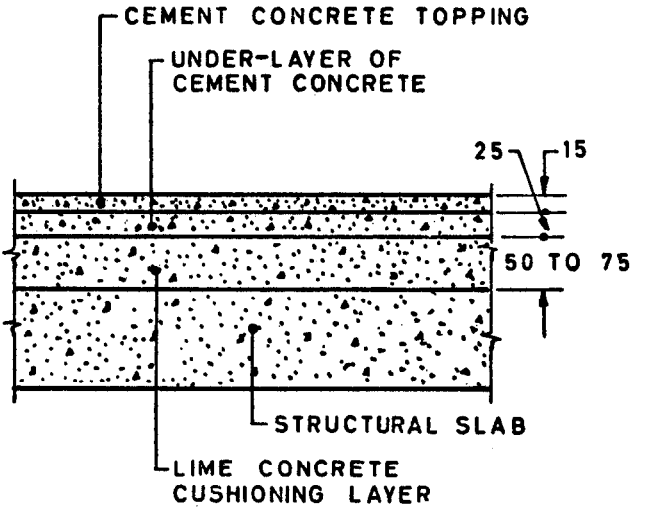


4A Topping Laid in Single Layer 4B Topping Laid in Two Layers

FIG. 4 BONDED FLOOR FINISH OVER STRUCTURAL SLAB



5A TOPPING LAID IN SINGLE LAYER



5B TOPPING LAID IN TWO LAYERS

All dimensions in millimetres.

FIG. 5 FLOOR FINISH ON STRUCTURAL SLAB LAID OVER CUSHIONING LAYER OF LIME CONCRETE

5.7.1 The joints in the floor finish shall extend through the borders and skirtings. If the skirting is laid monolithic with the flooring, a border of about 300 mm width must be provided alround the floor. The width of border provided around the floor when the skirting is not monolithic with floor finish shall not exceed 450 mm.

5.7.2 Construction joints between bays of the floor finish should be placed over any joints in the base concrete.

5.8 Protection Against Dampness — The layer of sand provided under the base concrete will generally serve the purpose of damp-proofing required for ordinary floors under normal conditions. However, in more severe conditions, where it is expected that the dampness may find its way on the top of the floor in the course of usage of floor, a more effective damp-proof treatment shall be given underneath the floor by either of the methods given below:

a) Laying the base concrete in two layers of thickness not less than 75 mm each and painting the top of the lower layer with two coats of hot bitumen of the industrial grade 85/25 conforming to IS : 702-1961* applied at the rate of 1·5 kg/m². The surface of the lower layer shall be finished smooth while laying the concrete so that bitumen can be applied uniformly. The bitumen shall be applied after the concrete has set and is sufficiently hard.

b) Sandwiching a waterproofing membrane, such as bituminous felt in the base concrete laid in two layers of thickness 75 mm each. The surface of the lower layer shall be finished smooth while laying the concrete so as to provide an even surface and thus prevent damage to the surface of waterproofing membrane.

5.8.1 Where it is expected that the dampness may find its way from the surrounding walls, the same shall also be effectively damp-proofed up to at least 150 mm above the level of the base or sub-floor, and the damp-proof treatment below the floor shall be extended over the walls. Basement floors shall be damp-proofed according to recommendations of IS : 1609-1966†.

5.9 Finish Over Stairs — The mix for finish over stairs shall be the same as for topping specified in **5.1** (*see also* Table 3). Risers shall be finished with the minimum thickness necessary to give an even surface to the structural concrete. For this purpose, 6 mm thick mortar finish will generally be sufficient, but thickness up to 10 mm may be provided where the surface of the structural concrete is found to be very uneven. Thickness of the finish at treads shall be not less than 20 mm for monolithic finish, and not less than 40 mm for finish laid over the hardened concrete.

*Specification for industrial bitumen (*revised*).

†Code of practice for laying damp-proof treatment using bitumen felts (*first revision*).

6. PROGRAMME OF WORK IN RELATION TO FLOOR FINISH

6.1 Before the flooring work is taken up, the following operations should have been completed:

a) The completion of all preliminary operations, such as laying of services affecting the schedule of commencement and completion of flooring; and

b) Plastering all the inside walls, ceilings and outside walls, and fixing of door frames in place. All heavy work in the room may be completed.

6.2 The sub-floor or base shall be finished to a reasonably true plane surface to a level which is lower than the level of the finished floor by the depth occupied by the thickness of the topping. The desired slope may be provided, where possible, in the base or sub-floor.

6.3 Before the floor finish work is started, all points or level for the finished surface shall be marked out. Wherever slope in finished floors is desired, points of level and outlets shall be correctly marked and outlet openings made beforehand.

7. PREPARATORY WORK

7.1 Handling and Storage of Materials — Clean and dry storage shall be provided at the site for all the materials. Cement shall not be stored in open. The materials shall be stored in accordance with IS : 4082-1967*.

7.2 Mixing of Materials

7.2.1 The aggregate and cement shall be thoroughly and efficiently mixed. Mixing shall be done using a mechanical mixer. Manual mixing may be permitted when the quantity of concrete mixed is small. The concrete shall be as stiff as possible and the amount of water added shall be minimum necessary to give just sufficient plasticity for laying and compacting. For improving the workability of the mix, thorough mixing rather than addition of more water shall be resorted to. Thorough mixing will improve the workability even for a very stiff mix and thus facilitate better finish. High water-cement ratio will increase the drying shrinkage and decrease the strength, water-tightness and abrasive resistance of the concrete.

7.2.2 The mix shall be used in the work within half-an-hour of the addition of water for its preparation.

*Recommendations on stacking and storage of construction materials at site.

8. LAYING CONCRETE FLOORING ON GROUND

8.1 Floor Finish Laid Monolithically with the Base Concrete (Finish Types I, IA and IB, Table 3)

8.1.1 *Preparation of Sub-base*

8.1.1.1 The ground or earth filling shall be thoroughly compacted so that there are no loose pockets left anywhere in the whole area. This shall then be covered with clean sand well consolidated to a thickness of not less than 100 mm. Great care is necessary in the preparation of the sub-base, as a settlement in the sub-base may cause the failure of the whole floor.

8.1.1.2 In situations, such as garrages where wheeled traffic comes into contact with the flooring, sub-base shall consist of well compacted sand layer of 100 mm thick and an additional 100 mm thick well compacted hard core of dry brick or stone ballast (40 mm size) blinded with *MOORUM* (disintegrated rock) or coarse sand.

8.1.1.3 In the case of expansive soils, like black cotton soil, stone ballast (40 mm graded aggregates) mixed with locally available yellow or red soil or soft *MOORUM* in 1 : 1 proportion shall be compacted to about 300 mm thickness and thoroughly saturated with water. This surface should be further covered with another 200 mm thick layer of soft *MOORUM* or cinder or sand and compacted properly before laying the base concrete. Special care is necessary in consolidation of the ground as otherwise the settlement of sub-base may cause cracking of the whole floor.

8.1.2 *Laying the Base* — The area to be paved shall be divided into suitable panels keeping in view the limits specified in **5.7.** This shall be done by fixing screed strips, the depth of which shall be equal to the combined thickness of the base concrete and the topping. Before being laid in position the screed strip shall preferably be coated with a thick coat of lime wash so as to prevent them from sticking to the concrete deposited in the panels.

8.1.2.1 Before placing the base concrete, the sub-base shall be properly wetted. The concrete shall then be deposited between the screed strips, thoroughly tamped and the surface screeded uniformly below the desired finished grade of flooring to accommodate the required thickness of topping. Any slope desired in the floor finish shall be given in the base concrete. The surface shall not be finished smooth but kept rough to provide adequate bond for the topping.

8.1.3 *Laying the Topping* — On the clean, green surface of the base concrete, the topping shall be placed in position as soon as possible but generally not later than two or three hours of laying the base concrete depending upon the temperature and the atmospheric conditions. The base concrete at the time of laying the topping shall be still green but

sufficiently firm to enable the workmen to work over it by placing planks on its surface.

8.1.3.1 The concrete mix for the topping shall be deposited on the base concrete in the screed strips already laid and thoroughly compacted to the finished thickness. Glass or aluminium strips may be provided for effective separation of panels and to provide straight edges and corners for the panels where good workmanship is required. The mix for the topping shall be stiff enough to prevent accumulation of any excess water or laitance on the surface. If water or laitance rises to the surface when consolidating (which indicates that too much of water has been used in the preparation of concrete) the concrete should preferably be scraped and replaced by a fresh mix. If it is desired to absorb surplus water for any reason, it should be mopped up; it should on no account be absorbed by spreading dry cement. The topping shall then be floated with a wooden float to render the surface even and after the surface is slightly hardened, it shall be finished smooth as described in **8.1.3.2**.

8.1.3.2 *Finishing the surface* — After the concrete has been fully compacted it shall be finished by trowelling or floating. Finishing operations shall start shortly after the compaction of concrete and shall be spread over the period of one to six hours depending upon the temperature and atmospheric conditions. The surface shall be trowelled three times at intervals so as to produce a uniform and hard surface. The satisfactory resistance of floor to wear depends largely upon the care with which trowelling is carried out. The object of trowelling is to produce as hard and close knit a surface as possible. The time interval allowed between successive trowellings is very important. Immediately after laying only just sufficient trowelling shall be done to give a level surface. Excessive trowelling in the earlier stages shall be avoided as this tends to work a layer rich in cement to the surface. Sometime, after the first trowelling, the duration depending upon the temperature, atmospheric conditions and the rate of set of cement used, the surface shall be retrowelled to close any pores in the surface, and to bring to surface and scrap off any excess water in concrete or laitance (it shall not be trowelled back into the topping). The final trowelling shall be done well before the concrete has become too hard but at such a time that considerable pressure is required to make any impression on the surface. Trowelling of a rich mix of dry cement and fine aggregate on to the surface shall not be permitted.

8.1.4 The base concrete and the topping shall be laid in alternate panels, the intermediate panels being filled in after one to two days depending upon the temperature and atmospheric conditions. The screed strips should be removed the next day after the concrete has been deposited in the panels and the edges of panels shall be examined for any honeycombing or undulation which, if found, shall be repaired straight and smooth by cement mortar. If the intermediate panels are not to be filled the next day the screed strips shall then be cleaned and put back

against the edges of panels till the concrete in the alternate panels is to be deposited. When the concrete is being deposited in the alternate panels the screed strips shall be removed. When the concrete is being compacted in new panels, care shall be taken to avoid damage to the panels already laid. If glass or aluminium strips are provided for effective separation of panels the base concrete and the topping may be laid in all the panels simultaneously.

8.2 Floor Finish Laid Separately on Hardened Concrete Base (Finish Type II, Table 3)

8.2.1 *Preparation of Sub-base* — The sub-base shall be prepared as described in **8.1.1.1, 8.1.1.2** and **8.1.1.3.**

8.2.2 *Laying the Base Concrete* — The base concrete may be deposited in the whole area at a stretch. Before placing the concrete the sub-base shall be properly wetted and rammed. The concrete shall then be deposited between the forms, where necessary, thoroughly tamped and the surface finished level with the top edges of the forms. The surface of base concrete shall be left rough to provide adequate bond for the topping. Two or three hours after the concrete has been laid in position, the surface shall be brushed with a hard brush to remove any scum or laitance and swept clean so that the coarse aggregate is exposed.

8.2.3 *Laying the Topping* — Before the operation for laying the topping is started the surface of base concrete shall be thoroughly cleaned of all dirt, loose particles, caked mortar droppings, and laitance, if any, by scrubbing with coir or steel wire brush. Where the concrete has hardened so much that roughening of surface by wire brush is not possible, the entire surface shall be roughened by chipping or hacking. Before laying the topping, the surface shall be soaked with water, at least for twelve hours and surplus water shall be removed by mopping immediately before the topping is laid in position.

8.2.3.1 The screed strips shall be fixed over the base concrete dividing it into suitable panels as recommended in **5.6**. The screed strips shall be so arranged that the joints, if any, in the base concrete shall coincide with the joints in the topping. Before placing the concrete mix for topping, neat cement slurry shall be thoroughly brushed into the prepared surface of the base concrete just ahead of the finish. The topping shall then be laid, very thoroughly tamped, struck off level and the surface floated with a wooden float. The surface shall be tested with the straight-edge and mason's spirit-level to detect any inequalities in the surface which, if any, shall be made good immediately. The finish shall be laid in alternate panels as described in **8.1.4** for topping laid monolithic with the base concrete.

8.2.3.2 *Finishing the surface* — The surface shall be fininshed as given in **8.1.3.2.**

8.2.4 *Laying the Topping in Two Layers* — Where the topping is to be laid in two layers to obtain very smooth and dense finish (*see* Finish Type III, Table 3), the sub-base, base concrete and under-layer of topping shall be laid as described in **8.2.1** to **8.2.3** with the exception that the surface of the concrete in the under-layer of topping shall not be finished smooth with a trowel but left rough after tamping it and levelling it with screed board.

8.2.4.1 The top 15 mm thick wearing layer of mix 1 : 2 to 3 cement concrete (depending upon the quality of finish and abrasive resistance desired) of consistency stiffer than that of under-layer concrete shall then be immediately laid over the rough but green surface of under-layer, and thoroughly tamped, struck off level, and the surface floated with wooden float. The surface shall then be tested with a straight-edge and mason's spirit-level to detect any undulation in the surface which, if any, shall be made good immediately. The surface shall then be finished smooth in accordance with **8.1.3.2**.

9. LAYING FLOOR TOPPING ON SUSPENDED SLABS

9.1 Floor Topping Laid Monolithically with the Structural/Suspended Slab (Finish Type IV, Table 3)

9.1.1 The form-work for structural slab shall be erected to the finished thickness of floor finish. Structural concrete shall be deposited in the forms, thoroughly consolidated and surface finished below the top edge of the form to accommodate the required thickness of the topping. Any slope required in the floor finish shall be given in the structural concrete itself, and any laitance or scum shall be brushed away from the surface of concrete when it is still green. The surface shall not be finished smooth but kept rough to provide an adequate bond for the topping.

9.1.2 On the green surface of the structural concrete, topping shall be placed in position immediately after the structural concrete has stiffened enough (but is still plastic) to allow for the workmen to tread over it by placing planks. Laitance and foreign matter, if any, shall be removed before the topping is placed in position. The topping shall be thoroughly campacted and screeded to the finished grade. The mix for the structural concrete as well as the topping shall be as stiff as possible consistent with workability so as to prevent accumulation of excess of water or laitance on the surface. The topping shall then be floated with a wooden float to render the surface even. After the surface is lightly hardened, it shall be finished in accordance with **8.1.3.2**.

9.2 Floor Topping Laid Directly over the Hardened Structural/Suspended Slab (Finish Types V and VI, Table 3)

9.2.1 *Preparation of Surface of Structural/Suspended Slab* — When the topping is to be laid separately but directly over the structural slab without any

cushioning layer, the structural concrete, 3 to 4 hours after its laying in the forms, shall be thoroughly brushed with a coir or steel wire brush to remove any scum or laitance and swept clean to expose the coarse aggregates and leave the surface rough.

9.2.2 *Laying Topping* — Before the operation of laying the topping is started the surface of structural slab shall be thoroughly cleaned of the dirt, loose particles, cake mortar droppings and laitance, if any, by scrubbing with coir or steel wire brush. Where the concrete has hardened so much that roughening of surface by wire brush is not possible, the entire surface shall be roughened by chipping or hacking.

9.2.3 The screed strips shall then be fixed over the structural slab dividing it into suitable panels as recommended in **5.7**. Immediately before depositing the concrete for the topping, neat cement slurry shall be thoroughly brushed into the prepared surface of the structural slab, just ahead of the finish. The topping shall then be laid, thoroughly tamped, struck off level and surface floated with a wooden float. The surface shall then be tested with a straight-edge and mason's spirit-level to detect any inequalities and undulations in surface which, if any, shall be made good immediately. The finish shall be laid in alternate panels as described in **8.1.4** and other laying and finishing operations shall be done as in **8.2.3** and **8.2.4** depending upon whether the topping is to be laid in single or two layers.

9.3 Floor Topping Laid over Cushioning Layer of Lime Concrete (Table 3)

9.3.1 *Preparing the Sub-floor* — Before laying the lime concrete, the surface of sub-floor shall be thoroughly cleaned of dirt, loose particles and laitance (in case of RCC slabs) by scrubbing with steel wire brushes. The surface shall then be thoroughly cleaned and soaked with water overnight and surplus water removed by mopping immediately before lime concrete is laid in position. On the clean damp surface of sub-floor, lime concrete shall then be evenly spread between forms, if necessary, thoroughly tamped and levelled. In the preparation and laying of lime concrete the relevant provisions of IS : 2541-1965* shall, as far as possible, be followed.

9.3.2 *Laying the Topping* — Before laying the topping, surface of lime concrete shall be thoroughly cleaned and prepared as recommended for base concrete in **8.2.2** and **8.2.3**. Immediately before spreading the concrete for topping, the surface shall be brushed with a thin layer of neat cement slurry. The topping whether in single or two layers shall then be laid as given in **8.2.3** and **8.2.4**.

10. FLOOR FINISH OVER STAIRS

10.1 Risers — After the structural concrete has set, the form-work for risers of stairs and landings shall be struck, laitance removed and the

*Code of practice for use of lime concrete in buildings.

surface of risers left rough to provide adequate bond for the finish. The risers shall then be finished with 1 : 3 cement mortar (*see* **5.9**).

10.2 Treads — Finishing to landings and stair treads shall be carried out as described for flooring in **9.1** and **9.2.**

11. CURING

11.1 Immediately after the flooring surface is finished it shall be protected from rapid drying by erecting barriers against wind or draught and strong sunlight. As soon as the surface has hardened sufficiently to prevent damage to it, it shall be kept continuously moist for at least fifteen days by means of wet gunny bags, 50 mm thick layers of damp sand spread over the surface or pooling water on the surface. During this period the flooring shall not be exposed to any traffic. Regular traffic on the floor should be allowed only after 28 days.

12. INSPECTION AND TESTING

12.1 Adhesion to the Base or Sub-floor — The adhesion between topping and the base may be examined by tapping the surface with the end of a rod or a hammer. A hollow sound indicates poor adhesion.

12.2 Loss of adhesion does not necessarily mean that the floor finish is unsuitable except when it is accompanied by visible curling of the edges of panels or cracks. Occasionally there is no lipping but the panel edges are noticeably higher than the centres of panels. In these circumstances the flooring may deflect and break under the loads likely to be imposed in use and must be considered unsuitable. Where the flooring is considered to be unsatisfactory, the topping concrete and any loose concrete in the base concrete shall be cut out and the base concrete keyed sufficiently to allow a sound renewal to be made. It is preferable and will probably be necessary, owing to the possible loosening of adjacent work by vibration, to renew the whole of the panel or panels where such defects occur.

APPENDIX A

(*Clause* 5.6)

SURFACE TREATMENT TO CEMENT CONCRETE FLOOR TOPPING

A-1. CLEANING THE SURFACE

A-1.1 The top surface of the concrete should be clean and free from grease or oil to enable the hardening solutions to penetrate. Sweeping to

remove dust and dirt may be adequate only in some cases of new floors and additional cleaning may be necessary. The top surface shall be wetted with water and scrubbed with coir or steel wire brush and thoroughly cleaned by washing with clean water. The floor should be allowed to dry so that the hardening solution can be absorbed into the surface.

A-2. TREATMENTS

A-2.1 Sodium Silicate — A solution containing one part by volume of sodium silicate and four to six parts of water should be spread evenly over the concrete top surface with a mop or soft brush. Any excess material should be wiped off and the floor allowed to dry. After the floor has been washed with clean water, a second coat, containing one part of sodium silicate to three or four parts of water, should be applied, and this should be allowed to dry similarly. A third coat may be applied after washing if the floor is still porous. After drying, the floor should be washed with hot clean water. Effective results are obtained if the treatment is applied seven to ten days after the end of curing.

A-2.2 Silico-Fluoride — The crystals of magnesium silico-fluoride or of zinc silico-fluoride should be dissolved in water at the rate of 0·1 g/cm³ for the first coat and 0·2 g/cm³ for subsequent coats. Three coats are usually applied at 24 hour intervals. There is no need to wash the top surface of the floor between coats, but it is advisable to wash with clean water after the final treatment.

A-2.3 Drying Oil and Surface Sealers — Drying oils, either neat or thinned with turpentine or white spirit, or surface sealers, may be applied to the top surface by brushing. Any excess should be wiped off about two hours after application.

A-2.4 Calcium chloride shall not be used with high alumina cement.

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