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

व्यापक परिचालन मसौदा

हमारा संदर्भः सीईडी 05/टी-21 **30 सितम्बर 2024**

तकनीकी समिति : फर्श, दीवार फिनिशिंग और छत अनुभागीय समिति, सीईडी 05

प्राप्तकर्ता :

क) सिविल इंजीनियरी विभाग परिषद्, सीईडीसी के सभी सदस्य
ख) सीईडी 05 के सभी सदस्य
ग) रूचि रखने वाले अन्य निकाय

प्रिय महोदय/महोदया,

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प्रलेख संख्या	शीर्षक
सीईडी 05 (26647) WC	**सिलिकेट प्रकार के रासायनिक प्रतिरोधी मोर्टार के उपयोग - रीति संहिता का भारतीय मानक मसौदा** (IS 4441 का *दूसरा पुनरीक्षण*), ICS 91.100.10

कृपया इस मानक के मसौदे का अवलोकन करें और अपनी सम्मतियॉ यह बताते हुए भेजे कि यदि यह मानक के रूप में प्रकाशित हो तो इस पर अमल करने में आपके व्यवसाय अथवा कारोबार में क्या कठिनाइयाँ आ सकती हैं ।

सम्मतियॉ भेजने की अंतिम तिथि : **30 अक्टूबर 2024**

सम्मति यदि कोई हो तो कृपया अधोहस्ताक्षरी को उपरिलिखित पते पर संलग्न फोर्मेट में भेजें या ced5@bis.gov.in पर ईमेल कर दें ।

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धन्यवाद ।

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द्वैपायन भद्र
(वैज्ञानिक 'ई' एवं प्रमुख)
(सिविल अभियांत्रिकी विभाग)

संगलन : उपरिलिखित

भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDARDS

MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG, NEW DELHI 110002

DRAFT IN WIDE CIRCULATION

Our Ref: CED 05/T-21 **30 September 2024**

Technical Committee: Flooring, Wall Finishing and Roofing Sectional Committee, CED 05

ADDRESSED TO:

1) All Interested Members of Civil Engineering Division Council, CEDC
2) All Members of CED 05 and its subcommittees,
3) All other interests.

Dear Sir/Madam,

Please find enclosed the following draft:

Doc No.	Title
CED 05 (26647) WC	**Draft Indian Standard Use of Silicate type Chemical Resistant Mortars — Code of practice** (*Second Revision* of IS 4441), ICS 91.100.10

Kindly examine the draft standard and forward your views stating any difficulties which you are likely to experience in your business or profession, if this is finally adopted as National Standard.

Last Date for Comments: 30 October 2024.

Comments, if any, may please be made in the format as enclosed and e-mailed to the undersigned at **ced5@bis.gov.in** in word format.

In case no comments are received or comments received are of editorial nature, you will kindly permit us to presume your approval for the above document as finalized. However, in case comments of technical nature are received, then this may be finalized either in consultation with the Chairman, Sectional Committee or referred to the Sectional Committee for further necessary action if so desired by the Chairman, Sectional Committee.

The document is also hosted on BIS website **www.bis.gov.in**.

Thanking you,

Yours faithfully,
Sd/-
(Dwaipayan Bhadra)
Head (Civil Engineering)

Encl: As above

FORMAT FOR SENDING COMMENTS ON BIS DOCUMENTS

(Please use A-4 size sheet of paper only and type within fields indicated. Comments on each clause/sub-clause/table/fig etc. be started on a fresh box. Information in column 3 should include reasons for the comments and suggestions for modified working of the clauses when the existing text is found not acceptable. Adherence to this format facilitates Secretariat's work) {Please e-mail your comments to ced5@bis.gov.in}

Doc. No.: CED 05 (26647) WC

Title: Draft Indian Standard Use of Silicate type Chemical Resistant Mortars — Code of practice (*Second Revision* of IS 4441)

LAST DATE OF COMMENTS: **30/10/2024**

NAME OF THE COMMENTATOR/ORGANIZATION: _____

Sl. No.	Clause/Para/Table/ Figure No. Commented	Comments/Modified Wordings	Justification of the Proposed Change

BUREAU OF INDIAN STANDARD

DRAFT FOR COMMENTS ONLY

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Draft Indian Standard

USE OF SILICATE TYPE CHEMICAL RESISTANT MORTARS – CODE OF PRACTICE

(*Second Revision* of IS 4441)

ICS 91.100.10

Flooring, Wall Finishing and Roofing Sectional Committee CED 05

Last date for Comment: 30 October 2024

FOREWORD

(Formal clauses will be added later)

The choice of an appropriate chemical resistant mortar for use in the construction activities as a bonding material requires adequate consideration. A particular type of mortar that may be able to resist a particular chemical environment may be completely unsuitable for another chemical environment. Therefore, the selection of a bonding material has to be entirely based on the specific chemical conditions.

Chemically setting silicate type mortars are resistant to most acids and are found to be satisfactory against nitric, chromic, sulphuric and hydrochloric acids. They are commonly used for bedding and jointing acid-proof bricks or tiles. However, they are not resistant to hydrofluoric and concentrated orthophosphoric acids. They are also not resistant to alkalies of any concentration, or to boiling water or steam and are likely to be deteriorated due to continued exposure to water or frequent washing with water. In view of the fact that the silicate type mortars develop chemical resistance by the physical bond formed by the chemical action of the acid with the mortar, it is important that the acid in contact with the mortar lining is sufficiently concentrated so as to have a *p*H value of 4 or less. It has been observed that if the mortar joints are exposed to acids having a *p*H value of more than 4, the chemical resistance as well as the strength of the mortar gets deteriorated. Therefore, silicate type mortars should not be used for containers of weak acids, effluent gutters and such other locations where continuous contact with acids having a *p*H value of 4 or less is not ensured or for floors where cleaning with water is frequently carried out.

Since the silicate mortars are porous, crystal formation with subsequent growth within the pores may disintegrate these mortars. In service involving salt solutions, changes in temperature or concentration may cause internal crystal formation. Sulphuric acids under certain conditions may react with the mortar to produce internal crystallization.

The manufacturer shall be consulted when such service conditions are anticipated, and in deciding between the use of sodium or potassium types of silicate mortars.

This standard, which was first published in 1967 and subsequently revised in 1980, is intended to provide guidance for the use of silicate type chemical resistant mortars. The present revision has been taken up mainly to incorporate the modifications necessary as a result of experience gained by the industry in the manufacture and application of such type of mortars. In this revision, the following major changes are incorporated:

a) Surface preparation method has been updated to ensure no expansion joint in acid lining area.
b) Bitumen Primer application guidelines have been clarified to emphasise the need for critical evaluation when in contact with oxidising agents.
c) Provisions for a slope have been included to prevent acid leaks onto concrete surfaces, facilitating efficient spill collection.

In the formulation of this standard due weightage has been given to the 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.

(The composition of the Committee responsible for the formulation of this standard will be added later.)

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 : 2022 ‘Rules for rounding off numerical values (second revision)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Draft Indian Standard

USE OF SILICATE TYPE CHEMICAL RESISTANT MORTARS — CODE OF PRACTICE

(*Second Revision of IS 4441*)

1 SCOPE

This standard lays down recommendations for the storage, mixing and method of use of silicate type chemical resistant mortars.

NOTE – The requirements of the silicate type mortar have been covered in IS 4832 (Part I).

2 REFERENCES

The standards listed in Annex A contains 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 these standards.

3 TERMINOLOGY

For the purpose of this standard, the following definitions shall apply:

3.1 Chemically Setting Silicate Type Chemical Resistant Mortars — An intimate mixture of a chemically inert solid filler, a setting agent usually contained in the filler, and a liquid silicate binder. When the filler and the binder are mixed at ordinary temperatures, a trowelable mortar is formed, which subsequently hardens by the chemical reaction between the setting agent and the liquid silicate binder.

3.2 *p*H Value — The logarithm of the reciprocal of the hydrogen ion concentration (expressed in g/l) of the solution.

4 STORAGE

4.1 The filler shall be protected from moisture during storage. If it is not feasible to store the filler under a roof at site, the filler shall be kept in the original containers under a waterproof cover.

4.2 The liquid binder shall be protected from freezing during storage until used. Under unavoidable circumstances, the liquid binder that has been frozen may be used, provided the liquid is thawed and thoroughly remixed before use, and can be restored to its original consistency.

5 MIXING

5.1 The proportions of filler to binder recommended by the manufacturer shall be used. Otherwise two to three parts by weight of filler to one part by weight of binder may be used. The optimum proportions might vary slightly due to climatic conditions, but it is important to have a mortar that is in paste form, workable and sufficiently stiff for the

masonry unit to retain its position without slipping or sliding, or without the mortar being exuded from the joint after the masonry unit has been placed in position.

5.2 Weigh the filler and the binder in separate containers according to the recommended proportion.

5.3 Add approximately three-quarters of the filler to the liquid binder in a clean pan or suitable container and mix with a trowel until all the filler has gone into paste. Add the remainder of the filler to the paste and continue mixing until the mortar is uniform.

5.4 In any batch only that quantity of the mortar that could be used before it starts setting shall be mixed. Since the setting time depends on the prevailing temperature, the quantity of mortar to be mixed shall be determined at the site by the person in charge of the work.

5.5 Mortar that has begun to set shall not be tempered by adding liquid binder or water but shall be discarded before preparing fresh batches.

5.6 Cement or water shall not be added to the silicate type mortar. Care shall be taken that the mortar does not come into contact with cement concrete surfaces that are still wet and has not yet set or cured.

5.7 When silicate mortars are to be exposed to temperatures below 10 °C or above 27 °C during mixing, application, or setting, special precautions shall be taken by addressing the mixing ratio of the ingredients. The manufacturer should be consulted for specific recommendations.

6 APPLICATION

6.1 Surface Preparation

The surface, on which the chemically resistant bricks conforming to IS 4860 or tiles conforming to IS 4457 are to be laid, shall be free from dirt and dampness and shall be properly cured and dried.

The surface on which the lining is proposed should be constructed out of RCC and should be designed to take the load as per IS 456. Layout of the structure should be done in such a way so that there are no expansion joints within the area proposed for acid lining. In case of acid-alkali resistant flooring, the lining should be provided with curbs, and it should be ensured that in no case should acid leak onto the concrete surface. The floors should be provided with a slope and should be ensured that in case of spillage, acids are quickly collected in acid spillage tanks where primary treatment is possible.

6.1.1 *Membrane* — The surface after preparation shall be applied with a coat of bitumen primer conforming to IS 158 if specified in specifications of the entire treatment. This is because when oxidising agents come into contact with the treatment in totality, the use of bitumen primer may be critically evaluated before its application. The primed surface shall be subsequently applied with a uniform coat of bitumen

conforming to IS 1580. If the bedding material is epoxy or polyester resin, the tiles or bricks may be laid directly on the surface without application of bitumen primer. In the case of furane, cashew nut shell liquid, and phenolic-type resins, a coat of bitumen primer conforming to IS 158 shall be used, subject to service conditions. Other membranes, such as rubber, polyisobutene, and fiber-reinforced plastics, may also be used in place of bitumen primer.

6.2 Mortar Application with Same Bedding and Jointing Materials

When bedding and jointing materials are same, the application of mortar is carried out as follows:

6.2.1 *On Floors* — Spread the silicate type mortar 6 to 8 mm thick on the back of the tile or brick. Smear two adjacent sides of the tile or brick with 4 to 6 mm thick mortar. Press the tile or brick into the bed and push against the floor and tile or brick until the joint in each case is 2 to 3 mm thick. Trim off excess mortar and allow it to harden fully. Cure the joints as given in **7.1**.

6.2.2 *On Walls* — Spread the silicate mortar 6 to 8 mm thick on the back of the tile or brick. Smear two adjacent sides of the tile or brick with 4 to 6 mm thick mortar. Press the tile or brick against the wall and with the adjacent tile or brick until the joint in each case is 2 to 3 mm thick. Trim off excess mortar. While carrying out the jointing, allow sufficient time to avoid the joints at the bottom getting disturbed and the tile or brick getting slided. Only one course of tile or brick shall be laid during the initial setting. Cure the joints as given in **7.1**.

6.3 Mortar Application with Different Bedding and Jointing Materials

When the job has to come into continuous contact with water, weaker acid solutions, and alkalies, silicate type mortar may be used for bedding, and resin or sulphur type mortar may be used for jointing. The job shall be carried out with only Class I bricks if used.

6.3.1 *On Floors* — Spread on to the back and two adjacent sides of the tile or brick the silicate type mortar 6 to 8 mm thick. Press the tile or brick on the bed and push against the floor and the tile or brick until the joint in each case is not more than 6 mm. Before the silicate mortar sets completely, remove the mortar in the joints to a depth of 20 mm or to the vertical thickness/depth of tile or brick. The mortar thus removed may be used for bedding, provided it is trowelable and has not hardened. After the bedding mortar is properly set, cure the joints as given in **7.2** and fill the joints full with the jointing mortar, taking care to fill up the entire length of the joint. Trim off excess mortar to make the joints smooth and plane.

6.3.2 *On Walls* — Spread onto the back and two adjacent sides of the tile or brick the silicate mortar 6 to 8 mm thick. Press the tile or brick against the wall and with the adjacent tile or brick until the joint in each case is not more than 6 mm. Only one course of tile or brick shall be laid during the initial setting time to avoid the joints at the bottom getting disturbed and the tile or brick getting slided. Before the silicate

mortar sets completely, remove the mortar in the joints to a depth of 20 mm. The mortar thus removed may be used for bedding provided it is trowelable and has not hardened. After the bedding mortar has properly set, cure the joints as given in **7.2** and fill the joints full with the jointing mortar taking care to fill up the entire length of the joint. If sulphur mortar is used, seal the vertical and horizontal joints with a strip of gummed paper 25 mm wide, to prevent the flow of sulphur mortar from the joints. Strip off the gummed paper after the mortar has hardened. Trim off excess mortar to make the joints smooth and plane.

7 ACID-CURING

7.1 Acid-curing shall be carried out in accordance with the manufacturer's directions, using the safety precautions normally used when handling acids. The operators shall be provided with suitable aprons, gloves, boots, etc. The mortar joints may be cured with 20 to 25 percent hydrochloric acid or with 30 to 40 percent sulphuric acid no sooner than 2 days and not later than 6 days after the masonry units have been bonded with the mortar. The curing time shall be at least 60 minutes. If the constructed unit is designed to contain a liquid, it may be filled with acid of the type and concentration stated above within the time interval stated, in lieu of washing the joints. In no case shall the acid solution be made by partially filling the tank with water and then adding acid. When sulphuric acid is used for curing, the solution shall not be prepared inside the unit.

NOTE — Twenty percent hydrochloric acid solution can be prepared by mixing 3 parts by volume of commercial 20° Baume hydrochloric acid with 2 parts by volume of water. Forty percent sulphuric acid solution can be made by mixing 2 parts by volume of commercial 66° Baume sulphuric acid with 5 parts by volume of water.

7.2 When the bedding material is silicate type mortar and the jointing material is epoxy resin type or polyester resin type or sulphur type mortar, no acid-curing is required. When the bedding material is silicate type and the jointing material is phenolic resin type or furane resin type or cashew nut shell liquid type, the joints shall be cured with acid as given in **7.1** before applying the jointing material.

7.3 The time interval between the bonding of the masonry unit and the time the construction may be put into service shall be that recommended by the manufacturer. In the case of non-silicate based mortar which do not require acid curing, the time interval shall be at least 48 hours. In the case of mortars requiring acid-curing, the time interval shall be at least 24 hours after acid-curing. In addition to the type of silicate mortar used, the curing time depends on the temperature and conditions under which the construction is to be used. The work shall be protected from contact with rain or water.

8 CHEMICAL RESISTANCE OF SILICATE TYPE MORTARS

8.1 A general guide for chemical resistance of silicate type mortars to various substances is given in Table 1. The ratings are for immersion service at ambient temperature and may usually be upgraded for spillage only. Specific

recommendations should be obtained from the manufacturer where conditions are questionable. The chemical resistance of silicate type mortars shall be determined in accordance with the method prescribed in IS 4456 (Part I).

TABLE 1 CHEMICAL RESISTANCE OF SILICATE TYPE MORTARS

(*Clause* 8.1)

Sl No.	**SUBSTANCE**	**CHEMICAL RESISTANCE**	
		Sodium Silicate Type	**Potassium Silicate Type**
(1)	(2)	(3)	(4)
	Acids:		
i)	Hydrochloric acid (concentrated)	R	R
ii)	Sulphuric acid (10 percent)	R	R
iii)	Sulphuric acid (10 to 50 percent)	L	R
iv)	Sulphuric acid (above 50 percent) (*see* Note)	N	R
v)	Nitric acid (concentrated)	R	R
vi)	Organic acids (concentrated)	R	R
vii)	Hydrofluoric acid (any strength)	N	N
	Alkalies:		
i)	Sodium hydroxide (any strength)	N	N
ii)	Sodium carbonate (any strength)	N	N
	Salt Solutions:		
i)	Acidic (*p*H value less than 4)	R	R
ii)	Alkaline	N	N
iii)	Neutral	L	L
	Solvents:		
i)	Aliphatic hydrocarbons	R	R
ii)	Aromatic hydrocarbons	R	R
iii)	Alcohols	R	R
iv)	Ketones	R	R
v)	Chlorinated hydrocarbons	R	R
	Fats and Oils	R	R

NOTES

1 R = Generally recommended.
L = Limited use (occasional spillage)
N = Not recommended.

2 Potassium silicate mortar used for resistance to sulphuric acid (above 90 percent), for a prolonged period, may cause crystal formation with subsequent growth within the pores and can disintegrate these mortars.

ANNEX A

(*Clause* 2)

LIST OF REFERRED STANDARDS

IS No.	*Title*
IS 158 : 2015	Ready mixed paint, brushing, bituminous, black, acid, alkali and heat resisting – Specification (f*ourth revision*)
IS 456 : 2000	Plain and Reinforced Concrete – Code of practice (*fourth revision*)
IS 1580 : 1991	Bituminous compounds for waterproofing and caulking purposes – Specification (*second revision*)
IS 4456 (Part 1) : 1967	Methods of test for Chemical Resistant Mortars: Part 1 Silicate type and Resin type
IS 4457 : 2007	Ceramic unglazed vitreous acid resisting tiles – Specification (s*econd revision*)
IS 4832 (Part 1) : 2023	Chemical Resistant Mortars – Specification Part 1 Silicate Type *(first revision)*
IS 4860 : 1968	Specification for Acid-resistant bricks