

**AMENDMENT NO. 5 JULY 2019
TO
IS 456 : 2000 PLAIN AND REINFORCED CONCRETE —
CODE OF PRACTICE**

(Fourth Revision)

[Page 13, clause 5.1 (a)] — Substitute the following for the existing:

‘a) Ordinary Portland Cement conforming to IS 269’

[Page 13, clause 5.1 (b) and (c)] — Delete.

(Page 13, clause 5.2) — Insert the following after the title:

‘Mineral admixtures listed below may be used along with ordinary Portland cement. Uniform blending of the mineral admixtures with the cement should be ensured.’

(Page 13, clause 5.2.1) — Substitute the following for the existing clause:

‘5.2.1 Pozzolanas

Pozzolanic materials, as given below, may be used.’

(Page 13, clause 5.2.1.1, line 3) — Delete the following:

‘provided uniform blending with cement is ensured’

[Page 13, clause 5.2.1.2 (see also Amendment No. 2)] — Delete the following:

‘provided uniform blending with the cement is ensured’

(Page 13, clause 5.2.1.4) — Substitute the following for the existing clause:

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‘5.2.1.4 Metakaolin

Metakaolin conforming to IS 16354 may be used as part replacement of ordinary Portland cement.’

(Page 13, clause 5.2.2) — Substitute the following for the existing clause:

‘5.2.2 Ground Granulated Blast Furnace Slag

Ground granulated blast furnace slag conforming to IS 16714 may be used as part replacement of ordinary Portland cement.’

(Page 14, clause 5.2.2) — Insert the following new clause:

‘5.2.3 Precautions

5.2.3.1 For concrete made with mineral admixtures, the setting time and rate of gain of strength may be different from those of concrete made with ordinary Portland cement alone. Cognizance of such modified properties shall be taken into account in deciding de-shuttering time, rate of movement of formwork in slipform construction, initial time of prestressing, longer curing period and for early age loading. The compatibility of chemical admixtures and cementitious materials should be ensured by trials.

5.2.3.2 Concrete containing mineral admixtures may exhibit an increase in plastic shrinkage cracking because of its low bleeding characteristics. The problem may be avoided by ensuring that such concrete is protected against drying, both during and after finishing.

5.2.3.3 Some other properties of concrete such as modulus of elasticity, tensile strength, creep and shrinkage are not likely to be significantly different. For design purposes, it will be sufficiently accurate to adopt the same values as those used for concrete made with ordinary Portland cement alone.

5.2.3.4 Mixes that contain very fine mineral admixtures such as silica fume, can be sticky and difficult to finish.

5.2.3.5 Concrete made using blended cements such as Portland pozzolana cement and Portland slag cement shall also adhere to 5.2.3.1, 5.2.3.2 and 5.2.3.3.’

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(Page 14, clause 5.3, line 1) — Insert, 'derived from natural sources and from other than natural sources,' after 'Aggregates'.

(Page 17, clause 8.1.1, para 3, first sentence) — Insert the following after first sentence:

'Maintenance plays an important role in sustained durability of concrete (see also 10.1).'

(Page 19, Table 4, Note 4) — Substitute the following for the existing:

'4 The cement contents given in col 7 of this table are the minimum recommended. For SO_3 contents near the upper limit of any class, cement contents above these minimum are advised. For the purpose of calculation of SO_3 content (if the test results are in the form of SO_4 , the following relation shall be used: $\text{SO}_3 = 0.833 \text{ SO}_4$.'

(Page 20, clause 8.2.5.3, line 6) — Insert '(where $\text{SO}_3 = 0.833 \text{ SO}_4$)' after ' SO_3 '.

[Page 20, clause 8.2.5.4, para 2, (b)] — Substitute the following for the existing:

- 'b) Use of low alkali ordinary Portland cement having total alkali content not more than 0.6 percent [as Na_2O equivalent (expressed as $\text{Na}_2\text{O} + 0.658 \text{ K}_2\text{O}$)].

Further advantage can be obtained by use of fly ash conforming to IS 3812 (Part 1) or ground granulated blast furnace slag conforming to IS 16714 as part replacement of ordinary Portland cement [having total alkali content as Na_2O equivalent (expressed as $\text{Na}_2\text{O} + 0.658 \text{ K}_2\text{O}$) not more than 0.6 percent], provided fly ash content is at least 25 percent or slag content is at least 50 percent.'

(Page 25, clause 11.3.1, line 4) — Delete the following:

'and where ordinary Portland cement is used and adequate curing is done'

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(Page 25, clause 11.3.1, informal table) — Substitute the following for the existing table:

Sl No.	Type of Formwork	Minimum Period Before Striking Formwork	
		For Concrete Made Using OPC	For Concrete Made Using Cement Other than OPC or Using Mineral Admixtures Like Fly Ash and Slag
(1)	(2)	(3)	(4)
i)	Vertical formwork to columns, walls, beams	16-24 h	16-24 h
ii)	Soffit formwork to slabs (Props to be refixed immediately after removal of formwork)	3 days	7 days
iii)	Soffit formwork to beams (Props to be refixed immediately after removal of formwork)	7 days	10 days
iv)	Props to slabs:		
	1) Spanning up to 4.5 m	7 days	10 days
	2) Spanning over 4.5 m	14 days	14 days
v)	Props to beams and arches:		
	1) Spanning up to 6 m	14 days	14 days
	2) Spanning over 6 m	21 days	21 days

NOTE — Utmost care shall be taken to provide props. The props shall be provided immediately after stripping each shuttering panel and not after stripping all the panels of the entire slab.

(Page 25, clause 11.3.1, last sentence) — Delete the words ‘other cements and’.

(Page 25, clause 11.3.1) — Insert the following new clause:

‘11.3.1.1 In case of use of cements other than OPC or in case of use of mineral admixtures like fly ash and slag, *in lieu* of the minimum period specified in 11.3.1 col 3, the stripping of formwork may be done in accordance with the provisions of 11.3.1 col 2, provided concrete cube testing is done to ensure that the following minimum strength is achieved:

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- a) 3 days : 45 percent of specified strength
- b) 7 days : 60 percent of specified strength
- c) 14 days : 85 percent of specified strength

(Page 26, clause 13.3.1, sentence one) — Substitute the following for the existing:

‘Concrete shall be compacted using mechanical vibrators complying with IS 2505, IS 2506 and IS 2514.’

(Page 33, clause 21.1, sentence four) — Substitute the following for the existing sentence:

‘Essential requirements of fire safety of buildings with respect to details of construction are given in IS 1642.’

[Page 45, clause 26.2.5.1 (g)] — Insert the following para at the end:

‘Reinforcement couplers for mechanical splices of bars for concrete reinforcement, used, shall be in accordance with IS 16172.’

(Page 72, clause 40.2.3.1) — Substitute the following for the existing:

‘40.2.3.1 For solid slabs, the nominal shear stress shall not exceed half the appropriate values given in Table 20.

Maximum shear stress, $\tau_{c \max}$ given in Table 20 is valid for all load cases including earthquake except the following:

- a) For coupling beams in coupled shear walls, under earthquake forces, the limiting value of $\tau_{c \max}$ given in Table 20 shall be superseded by 10 of IS 13920 : 2016.
- b) Coupled shear walls shall be connected by ductile coupling beams. If the earthquake induced shear stress in the coupling beam exceeds,

$$\frac{0.1 \ell_s \sqrt{f_{ck}}}{D}$$

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where ℓ_s is the clear span of the coupling beam and D is its overall depth, the entire earth quake induced shear and flexure shall, preferably, be resisted by diagonal reinforcement.

The area of reinforcement to be provided along each diagonal in a diagonally reinforced coupling beam shall be,

$$A_{sd} = \frac{V_u}{1.74 f_y \sin \alpha}$$

where V_u is the factored shear force and α is the angle made by the diagonal reinforcement with the horizontal. At least 4 bars of 8mm diameter shall be provided along each diagonal. The reinforcement along each diagonal shall be enclosed by special confining reinforcement, as per 8 of IS 13920 : 2016. The pitch of spiral or spacing of ties shall not exceed 100 mm.

The diagonal or horizontal bars of a coupling beam shall be anchored in the adjacent walls with an anchorage length of 1.5 times the development length in tension.'

(Page 77, Annex A) — Substitute the following for the existing entries against concerned Indian Standards:

<i>IS No.</i>	<i>Title</i>
269 : 2015	Ordinary Portland cement — Specification (<i>sixth revision</i>)
383 : 2016	Coarse and fine aggregate for concrete — Specification (<i>third revision</i>)
455 : 2015	Portland slag cement — Specification (<i>fifth revision</i>)
875 (Part 3) : 2015	Wind loads (<i>third revision</i>)
1489	Portland Pozzolana cement — Specification
(Part 1) : 2015	Fly ash based (<i>fourth revision</i>)
(Part 2) : 2015	Calcined clay based (<i>fourth revision</i>)
1641 : 2013	Code of Practice for fire safety of buildings (general) : General principles of fire grading and classification (<i>second revision</i>)

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<i>IS No.</i>	<i>Title</i>
1642 : 2013	Fire safety of buildings (general) : Details of construction — Code of Practice (<i>second revision</i>)
1786 : 2008	High strength deformed steel bars and wires for concrete reinforcement — Specification (<i>fourth revision</i>)
3812 (Part 1) : 2013	Pulverized fuel ash: Part 1 For use as pozzolana in cement, cement mortar and concrete (<i>third revision</i>)
6006 : 2014	Uncoated stress relieved strand for Prestressed concrete — Specification (<i>second revision</i>)
13920 : 2016	Ductile design and detailing of reinforced concrete structures subjected to seismic forces — Code of Practice (<i>first revision</i>)
14268 : 2017	Uncoated stress relieved low relaxation seven-wire (Ply) strand for prestressed concrete — Specification (<i>first revision</i>)

[Page 78, Annex A, entries pertaining to 'IS 4656 : 1968', 'IS 8112 : 1989', 'IS 12089 : 1987' and 'IS 12269 : 1987'] — Delete.

(Page 79, Annex A) — Insert the following new entries at the end:

<i>'IS No.</i>	<i>Title</i>
16172 : 2014	Reinforcement couplers for mechanical splices of bars for concrete reinforcement — Specification
16354 : 2015	Metakaolin for use in cement, cement mortar and concrete — Specification
16714 : 2018	Ground granulated blast furnace slag for use in cement, mortar and concrete — Specification

(CED 02)

Publication Unit, BIS, New Delhi, India