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MATERIAL CONSTANTS IN BUILDING WORKS

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

Indian Standard

MATERIAL CONSTANTS IN BUILDING WORKS

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Indian Standard

MATERIAL CONSTANTS IN BUILDING WORKS

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 8 January 1982, after the draft finalized by the Planning and Organization at Site Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 Schedule of rates form the basis for preparing the detailed estimates for works. These are also very useful in considering the reasonableness of the tenders received from the contractors and for pricing the alterations, additions, omissions and substitutions in a contract. It is, therefore, necessary that the schedule of rates should be prepared correctly and be based on rationally stipulated material and labour constants.

0.3 At present, different departments at a place are having their own schedule of rates. A comparison of the labour and material constants used for different items of work in these schedule of rates has indicated that there is a good variation in them and due to which different rates exist in various departments for the same items of work in the same locality. In order to rationalize the material constants for different items of building works, this standard is being issued.

0.4 The material constants have been arrived at by the Central Building Research Institute after carrying out the laboratory and field studies. All materials taken in the laboratory studies were as per relevant Indian Standards.

0.5 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.

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1. SCOPE

1.1 This standard covers the material constants (excluding wastages) for common items of building works.

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

NOTE 1 — The coverage of item is not exhaustive. Additional items will be included at a later date when data is available for these items.

NOTE 2 — The percentage of material wastage will vary depending upon region, source, type, season, mode of issue as well as utilization, etc. A correct assessment of wastage shall be determined by user's department.

2. MATERIAL CONSTANTS

2.1 Mortar — The material constants for cement mortars, lime mortars, lime pozzolana mortars and composite mortars are given in Table 1. The sand taken in the study was having fineness modulus of 1·26 and grading within limits as given in IS : 1542-1960* and IS : 2116-1965†.

2.2 Concrete — The material constants for cement concretes and lime concretes are given in Table 2.

2.2.1 The consumption of materials is more to an extent of 2·5 percent when the fineness modulus of sand is 1·26 instead of 3·87 which are almost extreme values maintaining the grading of sand within the permissible limits of IS : 383-1970‡. Similarly, the consumption of materials is more to an extent of 2·5 percent when the coarse aggregate with fineness modulus 6·05 is used instead of 7·60 which are also the extreme values. The over all consumption of materials in concrete is 5 percent less when aggregates with highest values of fineness modulus are used instead of those with lowest values of fineness modulus.

2.2.2 In Table 2, the fineness modulii of fine aggregate has been taken as 1·26 (fine sand) for leaner mixes and 2·87 (coarse sand) for richer mixes, for computing the constants. The fineness modulii for coarse aggregate are 6·9 for leaner mixes and 6·5 for richer mixes. The above sizes are taken as per normal practice maintaining the grading of the aggregates as per IS : 383-1970‡.

2.3 Brickwork — The material constants for brickwork using traditional bricks and modular bricks are given in Table 3 and Table 4 respectively.

2.4 Flooring

2.4.1 The material constants for cement concrete flooring are given in Table 5.

2.4.2 The material constants for terrazzo (marble chips) flooring are given in Table 6.

2.5 Plastering — The material constants for cement plasters and cement lime plasters are given in Table 7.

*Specification for sand for plaster.
†Specification for sand for masonry mortars.
‡Specification for coarse and fine aggregates from natural sources for concrete (*second revision*).

TABLE 1 MATERIAL CONSTANTS IN MORTARS

(*Clause* 2.1)

Sl No.	Item (Mix by Volume)	Constants per m^3 of Mortar			
		Cement (Bags)	Slaked Lime m^3	Surkhi m^3	Sand m^3
(1)	(2)	(3)	(4)	(5)	(6)
1.	Cement mortar 1 : 3 (1 cement : 3 sand)	8·48	—	—	0·90
2.	Cement mortar 1 : 4 (1 cement : 4 sand)	6·79	—	—	0·96
3.	Cement mortar 1 : 5 (1 cement : 5 sand)	5·6	—	—	0·99
4.	Cement mortar 1 : 6 (1 cement : 6 sand)	4·65	–	—	0·99
5.	Cement mortar 1 : 7 (1 cement : 7 sand)	4·06	—	—	1·01
6.	Cement mortar 1 : 8 (1 cement : 8 sand)	3·57	—	—	1·01
7.	Lime mortar 1 : 2 (1 lime : 2 sand)	—	0·45	—	0·90
8.	Lime mortar 1 : 3 (1 lime : 3 sand)	—	0·33	—	0·99
9.	Lime surkhi mortar 1 : 2 (1 lime : 2 surkhi)	—	0·50	1·00	—
10.	Lime surkhi mortar 1 : 3 (1 lime : 3 surkhi)	—	0·37	1·11	—
11.	Composite mortar 1 : 1 : 6 (1 cement : 1 lime : 6 sand)	4·48	0·16	—	0·96
12.	Composite mortar 1 : 2 : 9 (1 cement : 2 lime : 9 sand)	3·02	0·21	—	0·96

NOTE — 1 Water cement ratios adopted are for the percentage flow of 110 ± 5.

NOTE — 2 The sand and cement constant shall be reduced by up to 2 percent when the fineness modulus of sand is 2·9 and maintaining the grading as per relevant Indian Standards.

NOTE — 3 When lime is used in the form of putty, the volume V of slaked lime contained in one meter cube of lime putty is to be found as follows:

$$V = \frac{G\,(WP - 1\,000)}{(G - 1)\,D}$$

where G is specific gravity of slaked lime, W is weight of putty in kg/m^3 and D is bulk density of slaked lime in kg/m^3.

TABLE 2 MATERIAL CONSTANTS IN CONCRETE

(*Clause* 2.2)

Sl No.	Item (Mix by Volume)	Fineness Modulus		Size of Coarse (Normal Gauge)	Constants per m³ of Concrete					
		Fine Aggregate	Coarse Aggregate		Cement (bags)	Slaked Lime m³	Sand m³	Surkhi m³	Shingle* m³	Brick Ballast m³
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1.	Cement concrete 1 : 1 : 2 (1 cement : 1 sand : 2 shingle)	2·87	6·50	20 mm	9·76	—	0·35	—	0·70	—
2.	Cement concrete 1 : 1½ : 3 (1 cement : 1½ sand : 3 shingle)	2·87	6·50	20 mm	7·33	—	0·39	—	0·78	—
3.	Cement concrete 1 : 2 : 4 (1 cement : 2 sand : 4 shingle)	2·87	6·50	20 mm	5·84	—	0·41	—	0·82	—
4.	Cement concrete 1 : 3 : 6 (1 cement : 3 sand : 6 shingle)	2·87	6·50	40 mm	4·05	—	0·43	—	0·86	—
5.	Cement concrete 1 : 4 : 8 (1 cement : 4 sand : 8 shingle)	1·26	6·9	40 mm	3·20	—	0·45	—	0·90	—
6.	Cement concrete 1 : 5 : 10 (1 cement : 5 sand : 10 shingle)	1·26	6·9	40 mm	2·52	—	0·45	—	0·90	—

7.	Cement concrete 1 : 6 : 12 (1 cement : 6 sand : 12 shingle)	1·26	6·9	40 mm	2·10	—	0·45	—	0·90	—
8.	Lime concrete with brick aggregate and 40 percent lime mortar 1 : 2 (1 lime : 2 surkhi)	—	—	25 mm	—	0·22	—	0·44	—	1·0
9.	Lime concrete with brick aggregate and 50 percent lime mortar 1 : 2 (1 lime : 2 surkhi)	—	—	25 mm	—	0·24	—	0·52	—	1·04

NOTE — The material constants for 10 m^2 rendering (special finishes) to concrete surface shall be, cement : 0·51 bag, sand : 0·05 m^3.

*For crushed aggregate the constants shall be increased by 5 percent for leaner mixes and by 7 percent for richer mixes.

TABLE 3 MATERIAL CONSTANTS FOR BRICKWORK USING TRADITIONAL BRICKS

(2·9 × 11·1 × 7·0 cm with 1 cm thick mortar joints)

(*Clause* 2.3)

Sl No.	Description of Item	Constants per m^3				Frogdown			
		Frogup							
		Number of bricks	Cement (bags)	Slaked lime m^3	Fine sand* m^3	Number of bricks	Cement (bags)	Slaked lime m^3	Fine sand* m^3
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1.	Brickwork in cement mortar 1 : 3 (1 cement : 3 sand)	473	1·99	—	0·210	473	1·72	—	0·183
2.	Brickwork in cement mortar 1 : 4 (1 cement : 4 sand)	473	1·59	—	0·225	473	1·38	—	0·195
3.	Brickwork in cement mortar 1 : 5 (1 cement : 5 sand)	473	1·31	—	0·232	473	1·14	—	0·202
4.	Brickwork in cement mortar 1 : 6 (1 cement : 6 sand)	473	1·09	—	0·232	473	0·94	—	0·200
5.	Brickwork in cement lime mortar 1 : 1 : 6 (1 cement : 1 lime : 6 sand)	473	1.05	0·037	0·223	473	0·91	0·032	0·193
6.	Brickwork in cement lime mortar 1 : 2 : 9 (1 cement : 2 lime : 9 sand)	473	0·71	0.05	0·226	473	0·61	0·045	0·194

7. Half brick masonry in cement mortar 1 : 3 (1 cement : 3 sand)	520	1·88	—	0·200	520	1·59	—	0·169
8. Half brick masonry in cement mortar 1 : 4 (1 cement : 4 sand)	520	1·51	—	0·214	520	1·28	—	0·181
9. Half brick masonry in cement lime 1 : 1 : 6 (1 cement : 1 lime : 6 sand)	520	0·99	0·035	0·210	520	0·84	0·030	0·178

NOTE — The mortar consumption per m^3 of brickwork shall be 0·234 m^3 and 0·203 m^3 for 'Frogup' and 'Frog-down' use of bricks respectively.

*The sand and cement constants shall be reduced by 2 percent when coarse sand (fineness modulus 2·9) is used.

TABLE 4 MATERIAL CONSTANTS FOR BRICKWORK WITH MODULAR BRICKS

(*Clause* 2.3)

Sl No.	Description of Item	Constants per m^3				Frogdown			
		Frogup							
		Number of bricks	Cement (bags)	Slaked lime m^3	Fine sand* m^3	Number of bricks	Cement (bags)	Slaked lime m^3	Fine Sand* m^3
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1.	Brickwork in cement mortar 1 : 3 (1 cement : 3 sand)	517	1·76	—	0·187	517	1·58	—	0·168
2.	Brickwork in cement mortar 1 : 4 (1 cement : 4 sand)	517	1·41	—	0·200	517	1·26	—	0·178
3.	Brickwork in cement mortar 1 : 5 (1 cement : 5 sand)	517	1·16	—	0·205	517	1·04	—	0·184
4.	Brickwork in cement mortar 1 : 6 (1 cement : 6 sand)	517	0·96	—	0·204	517	0·87	—	0·182
5.	Brickwork in cement lime mortar 1 : 1 : 6 (1 cement : 1 lime : 6 sand)	517	0·93	0·033	0·198	517	0·83	0·029	0·176
6	Brickwork in cement lime mortar 1 : 2 : 9 (1 cement : 2 lime : 9 sand)	517	0·63	0·044	0.201	517	0·56	0·040	0·178
7.	Half brick masonry in cement mortar 1 : 3 (1 cement : 3 sand)	506	1·35	—	0·143	506	1·18	—	0·125
8.	Half brick masonry in cement mortar 1 : 4 (1 cement : 4 sand)	506	1·08	—	0·153	506	0·94	—	0·133
9.	Half brick masonry in cement lime mortar 1 : 1 : 6 (1 cement : 1 lime 6 sand)	506	0·62	0·022	0·132	506	0·71	0·025	0·151

NOTE — The mortar consumption per m^3 of brickwork shall be 0·207 m^3 and 0·186 m^3 for 'Frogup' and 'Frogdown' use of bricks respectively.

*The sand and cement constants shall be reduced by 2 percent when coarse sand (fineness moduls 2·9) is used.

TABLE 5 MATERIAL CONSTANTS FOR CEMENT CONCRETE FLOORING

(*Clause* 2.4.1)

Sl No.	Description of Item	Constants for 10 m^2		
		Cement (bags)	Sand (coarse) m^3	Coarse Aggregate (shingle)* m^3
(1)	(2)	(3)	(4)	(5)
1.	75 mm thick cement concrete flooring 1 : 2 : 4 (1 cement : 2 sand : 4 shingle 20 mm nominal gauge) finished with a floating coat of neat cement	4·81	0·31	0·62
2.	50 mm thick cement concrete flooring 1 : 2 : 4 (1 cement : 2 sand : 4 shingle 20 mm nominal gauge) finished with a floating coat of neat cement	3·35	0·21	0·42
3.	40 mm thick cement concrete flooring 1 : 2 : 4 (1 cement : 2 sand : 4 shingle 20 mm nominal gauge) finished with a floating coat of neat cement	2·80	0·164	0·328
4.	25 mm thick cement concrete flooring 1 : 2 : 4 (1 cement : 2 sand : 4 shingle 20 mm nominal gauge) finished with a floating coat of neat cement.	1·89	0·103	0·206

*Constants for concrete shall be increased by up to 7 percent when crushed aggregate is used in place of shingle.

TABLE 6 MATERIAL CONSTANTS FOR TERRAZZO (MARBLE CHIPS) FLOORING

(*Clause* 2.4.2)

Sl No.	Description of Item	Constants per 10 m³						Remarks
		Cement (bags)	Sand m³	Coarse aggregate m³	Cement (bags)	Marble powder kg	Marble chips kg	
		Under layer			Top layer			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1.	40 mm thick marble chips flooring rubbed and polished to granolithic finish under layer 35 mm thick cement concrete 1 : 2 : 4 (1 cement : 2 coarse sand : 4 stone aggregate — shingle 20 mm nominal gauge) and top layer 5 mm thick white black or white and black marble chips of size 2-4 mm (Grade No. 0) laid in proportion 1 : 1¾ (one binder : 1¾ chips-binder consists of cement and marble powder in ratio 3 : 1 by weight)	2·04	0·144	0·288	0·52	8·65	61·10	
2.	40 mm thick marble chips flooring rubbed and polished to granolithic finish under layer 30 mm thick cement concrete 1 : 2 : 4 (1 cement : 2 coarse sand : 4 stone aggregate — shingle 20 mm nominal gauge) and top layer 10 mm thick white black or white and black marble chips of size 7-10 mm (Grade No. 2) laid in cement proportion 1 : 1½ (one binder : 1½ chips-binder consists of cement and marble powder in ralio 3 : 1 by weight)	1·75	0·124	0·248	1·13	18·9	118·8	

TABLE 7 MATERIAL CONSTANTS FOR PLASTERING

(*Clause* 2.5)

Sl No.	Description of Item	Constants for 10 m²					
		On Traditional Brickwork			On Modular Brickwork		
		Cement (bags)	Slaked lime m³	Sand* (fine) m³	Cement (bags)	Slaked lime m³	Sand* (fine) m³
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1.	12 mm cement plaster 1 : 3 (1 cement : 3 sand)	1·22	—	0·130	19	—	0·126
2.	12 mm cement plaster 1 : 4 (1 cement : 4 sand)	0·98	—	0·138	0·95	—	0·134
3.	12 mm cement plaster 1 : 5 (1 cement : 5 sand)	0·81	—	0·143	0·78	—	0·139
4.	12 mm cement plaster 1 : 6 (1 cement : 6 sand)	0·67	—	0·143	0·65	—	0·139
5.	15 mm cement plaster 1 : 3 (1 cement : 3 sand) on rough side of one brick wall	1·48	—	0·158	1·45	—	0·154
6.	15 mm cement plaster 1 : 4 (1 cement : 4 sand) on rough side of one brick wall	1·19	—	0·168	1·16	—	0·164
7.	15 mm cement plaster 1 : 5 (1 cement : 5 sand) on rough side of one brick wall	0·98	—	0·173	0·96	—	0·169
8.	15 mm cement plaster 1 : 6 (1 cement : 6 sand) on rough side of one brick wall	0·81	—	0·173	0·80	—	0·169
9.	20 mm cement plaster 1 : 3 (1 cement : 3 sand)	1·92	—	0·203	1·88	—	0·200

— (*Continued*)

TABLE 7 MATERIAL CONSTANTS FOR PLASTERING — *Contd*

Sl No.	Description of Item	Constants for 10 m²					
		On Traditional Brickwork			On Modular Brickwork		
		Cement (bags)	Slaked lime m³	Sand* (fine) m³	Cement (bags)	Slaked lime m³	Sand* (fine) m³
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
10.	20 mm cement plaster 1 : 4 (1 cement : 4 sand)	1·53	—	0·217	1·51	—	0·213
11.	20 mm cement plaster 1 : 5 (1 cement : 5 sand)	1·27	—	0·224	1·24	—	0·220
12.	20 mm cement plaster 1 : 6 (1 cement : 6 sand)	1·05	—	0·224	1·03	—	0·220
13.	12 mm cement lime plaster 1 : 1 : 6 (1 cement : 1 slaked lime : 6 sand)	0·65	0·023	0·138	0·63	0·022	0·134
14.	12 mm cement lime plaster 1 : 2 : 9 (1 cement : 2 slaked lime : 9 sand)	0·43	0·030	0·138	0·42	0·029	0·134
15.	15 mm cement lime plaster 1 : 1 : 6 (1 cement : 1 slaked lime : 6 sand)	0·78	0·028	0·168	0·77	0·027	0·164
16.	15 mm cement lime plaster (1 : 2 : 9 (1 cement : 2 slaked lime : 9 sand)	0·53	0·037	0·168	0·52	0·036	0·164

NOTE — The thickness of joints and depth of raking has been taken as one centimetre for computation of constants.

*The sand and cement constants shall be reduced by 2 percent when fineness modulus of sand is 2·9 and maintaining the grading as per relavent Iudian Standards.

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