BUILDING DIGEST

CENTRAL BUILDING RESEARCH INSTITUTE INDIA

MASONRY MORTARS

Mortar may be defined as an intimate mixture having the consistency of a paste and prepared by mixing various proportions of a building material, fine aggregate and water.

Desirable Properties of Mortar

A mortar should possess the following properties:—

1. It should possess good working qualities to provide ease of spreading and ensure that all joints are properly filled.
2. It should have certain initial hardening characteristic so that building operation continues without delay.
3. It should have sufficient strength to carry the imposed load.
4. It should be durable and able to withstand the action of weathering, corrosion and effloresence.

Types of Mortars

In practice the above requirement cannot be fully attained in one single mortar composition, therefore, the selection of mortar should be done to suit a particular type of work.

Cement Mortar

Cement mortars consists of cement and sand. These harden rapidly, attain high strengths at early age, possess high shrinkage on settling and a high degree of rigidity. Sometimes lime is added to increase workability, reduce shrinkage and the rate of stiffening of cement mortar.

Lime Mortars

Lime mortars contain lime and sand. Usually 2 to 3 volumes of sand are added to one volume of dry hydrated lime. High calcium lime is used in the form of putty which imparts better workability. Lime mortars have high water-retentivity, plasticity and capacity for autogenous healing. Since these harden by drying and by carbonation brought about by the absorption of carbon dioxide from atmosphere the development of strength is rather slow. Hydraulic or semi-hydraulic limes have the property of setting under water and are used when a situation demands an early gain in strength and higher ultimate strengths.

Lime-Pozzolana Mortars

In these mortars lime and pozzolana are the main constituents. Lime may be either non-hydraulic or semi-hydraulic. Surkhi and cinder are the two pozzolanas that are commonly used. Sometimes a part of surkhi or cinder is replaced by sand. Lime-pozzolana mortars possess hydraulic properties and attain strength higher than that of straight lime-sand mortars.

Composite Mortars

Composite or gauged mortars contain both cement and lime in varying proportion. (Lime should be either non-hydraulic or semi-hydraulic). These are known to possess good properties of both cement and lime mortars. They have good strength, workability, water retention and bonding properties. Use of these mortars results in a more watertight masonry as shrinkage cracking is considerably reduced.

Aerated Cement Mortars

These contain a small amount of entrained air by incorporating a small quantity of air entraining agent in a mix. The workability of a lean cement-sand mortar is thus improved and bleeding and segregation are reduced.

Materials for Mortar

Cement

Cement should comply with the requirement of IS : 269–1958 for ordinary portland cement. It should be free from air set lumps and show no sign of hydration.

Lime

It may be fat, semi-hydraulic or hydraulic lime and should conform to IS : 712-1956. Non-hydraulic and semi-hydraulic limes should be converted to putty

ıal weight of the hydrated lime which the ıins may be determined by the following

W = G/G−1 (Wp−62.4)

W = Weight of dry hydrated lime in one cu. ft. of putty.

G = Specific gravity of hydrated lime, (usually 2.25 for fat lime and 2.75 for semi-hydraulic lime).

W = Weight of putty per cubic foot.

ould be inert, hard, water insoluble and d, alkali or organic matter. It should pass tions laid down in BS 1200, 1955 and ulus should be in the range of 1.15 to 2.95 ıdian Standard for sand for masonry mortar the same limit).

ld be clean and free from admixture of ·ial. It should have a fineness modulus e of 0.75 to 1.35. It should pass IS : 1344- ested for lime reactivity. Use of surkhi of ter than 2350 sq. cm./g. necessitates addi- in mortars.

r furnace clinker) should be clean and free a proportion of urburnt carbon and com- ining sulphur. Fineness of cinder may be ıe as that for surkhi.

t for drinking is normally suitable. It ın and free from deleterious matter.

ortar

r

ent and sand should first be mixed thorou- y state on a clean watertight platform. added and the mixing continued until the s the right workable consistency. A sim- lge the right consistency is to take a trowel out of the mortar. It should come out

portioning of the materials is done by (i) olume of packed cement and loose sand and loose cement and loose sand.

method is considered most accurate and lopted wherever possible. The second venient and is normally used in the field ; ıe of sand may vary with the method of handling it in the measure and this affects the mix proportion slightly. The third method is not recommended because the quantity of cement can vary considerably owing to difference in its fineness and packing.

Lime Mortar

Slaking of lime should be done in accordance with IS : 1635-1960 'Code of Practice for field slaking of Lime'.

Hydrated lime or lime putty is mixed with dry sand and ground in a motar mill. The object of grinding is to effect an ultimate mix of the ingredients so that no two grains of sand should be together without an intervening film of lime. The required quantity of water is added during grinding to bring the mortar to the workable consistency.

Lime-Pozzolana Mortar

The same procedure as for lime-sand mortar should be followed. Sand if required, should then be added to the mix and grinding repeated till every aggregate particle gets coated with the cementitious material.

Composite Mortar

Composite mortar is usually prepared by first making a wet mix of lime and sand often known as coarse stiff. Lime is mixed with the required amount of sand and ground to obtain the mortar in the manner described above. The mortar can be used immediately if lime putty is used but if dry hydrated lime is used it is better to let the mix stand overnight before using it. The wet storage will improve its working qualities.

Immediately before use, the required amount of cement should be added to the coarse stiff followed by extra water to get the proper consistency.

Aerated Mortar

Aerated mortar is mixed mechanically. The predetermined amount of air-entraining agent is added to the mixing water in the mixer. Cement is next added and the mixer started to obtain a slurry. Finally sand is introduced. Sufficient quantity of water should be added to obtain the desired workability. The mixer should have a revolving paddle which cuts into the mortar and entrains air.

Practical Hints

(a) The quantity of water added in preparing mortar should be just sufficient to give good workability. The use of too much water should be avoided as it reduces strength, increases shrinkage and impairs the bond between the brick and the mortar.

(b) Partly set or dried cement mortar should never be tempered for reuse.

(c) Lime should never be added to high alumina cement mortar.

(d) Cement should not be used with hydraulic lime mortars.

(e) Lime should be completely slaked.

(f) Magnesium limes are not suitable for use in mixes containing cement, since they contain overburnt magnesia some of which may not hydrate when lime is slaked. It slakes slowly and expands on hydration which may cause defects or failure in the building.

(g) Fresh and clean water should be used.

Recommended Mixes

The selected mortar should impart to masonry adequate strength and resistance to rain penetration. The strength of masonry increases upto a certain limit with the increase in the strength of mortar, beyond which there is practically no gain in strength. Also the strength of masonry is not proportional to the strength of the mortar and a rich mix does not necessarily increase the strength of the masonry. For example, the strength of medium strength brick masonry built in 1 : 6 cement-sand mortar is about 90 per cent of that in 1 : $\frac{1}{4}$: 4 cement-lime-sand even though the strength of the cement sand mortar is only about 60 per cent of that of cement-lime-sand mortar.

In masonry, rain water generally penetrates through the mortar joints. For a masonry to be watertight, extent of bond (Area of contact between mortar and building unit) is more important than the bond strength. The former depends primarily on the water retaining capacity of a mortar and suction capacity of the building unit. The bricks in India have generally a high suction capacity and tend to draw water from the mortar before it hardens. Mortars with high water retention capacity are therefore preferable. Composite mortars are superior to cement mortars in this respect and increase watertightness of the masonry.

Strong mortar should not be used in the masonry as it will crack away from the unit due to initial drying shrinkage. Most of the shrinkage cracking of walls occurs during the first drying of the building. Compared to other mortars, lime-pozzolana motars possess a higher prehardening shrinkage and, if drying is quick, they may crack. However, once they have hardened, their resistance to cracking will be greater than that of cement sand mortar because of their lower modulus of elasticity and reduced volume changes.

Aerated mortars may be used when either the quality of available lime is poor or transportation of lime increases the cost.

Recommended mortar mixes under various conditions of loading are given in Tables 1 and 2.

Table 1—**Mortar for Masonry in Foundation and Plinth**

Condition of Subgrade	Loading per sq. ft.	Mortar mix Proportion	Remarks
1. Moist subgrade with sub-soil water less than 5 ft. below foundation level and high percentage of soluble sulphate.	Heavy and medium loading (4 tons or more)	1C : 3S	Use of high Alumina cement or pozzolanic cement is recommended.
	Light loading (4 tons or less)		
	(a) below ground level	1C : 3S	High Alumina or pozzolanic cement is preferred.
	(b) In plinth.	1C : 1L : 6S, 1C : 6S	
2. Moist subgrade as in (1) with little or no soluble sulphate.	Heavy and medium loading (4 tons or more)	1C : 6S, 1C : 1L : 6S	Class B or C lime.
	Light loading (4 tons or less)	1C : 6S, 1C : 1L : 6S	
3. Dry subgrade with subsoil water never within 5 ft. of foundation level.	Heavy loading (4 tons or more)	1C : 6S, 1C : 1L : 6S	
	Light loading (4 tons or less)	1L : 2–3S	Class A lime.
		1L : 1 Surkhi : 2S 1L : 1 Cinder : 2S.	Class B or C lime.
		1L : 2–3 Surkhi 1L : 2–3 Cinder 1C : 3L : 12S	

Table 2—**Mortar for Masonry in Superstructure**

No.	Situation	Loading (Ton/sq. ft.)	Type of Masonry	Mortar mix Proportion (By Vol.)
1.	Load bearing walls	Very heavy loading (8–10)	Brick or concrete blocks with crushing strength not less than 1500 lbs. per sq. inch.	1C : 6S 1C : 1L : 6S
2.	—do—	Heavy loading (6–8)	Brick or stone or concrete block with crushing strengh not less than 1000 lbs./sq. ft.	1C : 2L : 9S
3.	—do—	Medium loading (4–6)	—do—	1L : 1 Surkhi : 1-2S 1L : 1 Cinder : 1-2S 1L : 2 Surkhi 1L : 2 Cinder 1L : 2–3S (Class A) 1C : 2L : 9S
4.	—do—	Arch. Work	Dense brick, lime stone or granite	1C : 3S
5.	—do—	Light loading (below 4 tons).	Brick or Concrete blocks	Same as in medium loading.
6.	Cavity walls	—	Brick	1C : 6S 1C : 1L : 6S
7.	Brick on edge parapet walls	—	—do—	1C : 6S 1C : 1L : 6S
8.	Reinforced brick work	—	—do—	1C : 3S
9.	Non-load bearing partition walls	—	Brick, lightweight concrete, hollow blocks.	1L : 3S (Class A) 1C : 2L : 9S 1C : 3L : 12S

C = Portland cement
L = Hydrated lime
S = Sand

There is a demand for short notes summarising available information on selected building topics for the use of Engineers and Architects in India. To meet the need this Institute is bringing out a series of Building Digests from time to time and the present one is the Twenty-sixth in the series.

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