



Cement Mortar

Cement mortar is a building compound created by mixing sand and a selection of aggregates with a specified amount of water. The mortar can be used for a number of applications, such as plastering over bricks or other forms of masonry. Sometimes referred to as sand cement, mortar blends today often incorporate different grades of plastics to create various types of polymer cement mortars.

For the calculation of cement mortar, let us assume that we use 1m^3 of cement mortar. Considering voids in sands, we assume that materials consists of 60% voids. That is, for 1m^3 of wet cement mortar, 1.6m^3 of materials are required.



Cement Mortar

Requirements of mortar

- It should have good adhesion with bricks, stones.
- It should resist penetration of rain water.
- It should be cheap, durable, and workable.
- It should be set quickly.
- The joints formed by mortar should not develop cracks.
- To bind the bricks or stones firmly in wall construction work.
- They are used in plaster work as finishing material to provide weather resistance joints of masonry work are covered by plaster work. White wash and colour are applied on plastered surface easily.

Properties of mortar

- Mobility.
- Place ability.
- Water retention



Compressive strength of cement

(IS:4031Part 6-1988)



- (i) The mortar of cement and sand is prepared. The proportion is 1:3 which means that (X) gm of cement is mixed with 3(X) gm of sand.
- (ii) The water is added to the mortar. The water cement ratio is kept as 0.4 which means that (X) gm of water is added to dry mortar.
- (iii) The mortar is placed in moulds. The test specimens are in the form of cubes with side as 70.6 mm or 76 mm. The moulds are of metal and they are constructed in such a way that the specimens can be easily taken out without being damaged. For 70.6 mm and 76 mm cubes, the cement required is 185 gm and 235 gm respectively.
- (iv) The mortar, after being placed in the moulds, is compacted in vibrating machine for 2 minutes.
- (v) The moulds are placed in a damp cabin for 24 hours.



Compressive strength of cement (IS:4031Part 6-1988)

(vi) The specimens are removed from the moulds and they are submerged in clean water for curing.

(vii) The cubes are then tested in **compression testing machine** at the end of 3 days and 7 days. The testing of cubes is carried out on their three sides without packing. Thus three cubes are tested each time to find out the compressive strength at the end of 3 days and 7 days. The average value is then worked out. During the test, the load is to be applied uniformly at the rate of 350 kg/cm^2 or 35 N/mm^2 .

(viii) The **compressive strength of cement** at the end of 3 days should not be less than 115 kg/cm^2 or 11.50 N/mm^2 and that at the end of 7 days should not be less than 175 kg/cm^2 or 17.50 N/mm^2 .



CEMENT TYPE	COMPRESSIVE STRENGTH (Mpa)			
	1 Day	3 Days	7 Days	28 Days
OPC(33)	—	16	22	33
OPC(43)	—	23	33	43
OPC(53)	—	27	27	53
SRC	—	10	16	33
PPC	—	16	22	33
RHPC	16	27	—	—
PSC		16	22	33
High alumina	30	35	—	—
Super sulphated	—	15	22	30
Low heat	—	10	16	35
Masonry	—	—	2.5	5.0
IRS-T-40	—	—	37.5	—



Tensile strength of cement



Tensile Strength of Cement test was formerly used to have an indirect indication of [compressive strength of cement](#). It is at present generally used for the [rapid hardening cement](#).

Tensile Strength of Cement Test Procedure:

- (i) The mortar of cement and sand is prepared. The proportion is 1:3 which means that (x) gm of cement is mixed with 3(x) gm of sand.
- (ii) The water is added to the mortar. The quantity of water is 5 per cent by weight of cement and sand.
- (iii) The mortar is placed in briquette moulds. A typical briquette is shown in below figure. The mould is filled with mortar and then a small heap of mortar is formed at its top. It is beaten down by a standard spatula till water appears on the surface. Same procedure is repeated for the other face of briquette. Such twelve standard briquettes are prepared. The quantity of cement may be 600 ml for 12 briquettes.



Tensile strength of cement

- (iv) The briquettes are kept in a damp cabin for 24 hours.
- (v) The briquettes are carefully removed from the moulds and they are submerged in clean water for curing.
- (vi) The briquettes are tested in testing machine at the end of 3 days and 7 days. Six briquettes are tested in each test and average is found out. During the test, the load is to be applied uniformly at the rate of 35 kg/cm^2 or 3.50 N/mm^2 .
- (vii) It may be noted that cross-sectional area of briquette at its least section is 6.45 cm^2 . Hence the ultimate tensile stress of cement paste is obtained from the following relation:
Ultimate tensile stress = failing load / 6.45
- viii) The tensile stress at the end of 3 days should not be less than 20 kg/cm^2 or 2 N/mm^2 and that at the end of 7 days should not be less than 25 kg/cm^2 or 2.50 N/mm^2 .



Setting time of cement (IS: 4031 (Part 5) – 1988)

Generally Initial setting is the time elapsed between the moment water is added to the cement to the time at which paste starts losing its plasticity. Final setting time of cement is the time elapsed between the moment the water is added to the cement to the time at which paste has completely lost its plasticity and attained sufficient firmness to resist certain definite pressure.

30 min are given while handling these mixing operations, here fineness of cement and suitable constituents are maintained in such a way that concrete is remained in plastic condition for handling procedures.

Once the concrete is finally placed it should lose its plasticity, so that it is least vulnerable to damages from external agencies. This time should not be more than **10hrs** which is referred as **Final setting time of cement**.



Setting time of cement (IS: 4031 (Part 5) – 1988)

To modify the concrete properties i.e to shorten the time of setting or to delay the setting time of cement Admixtures are used and they are as follows:

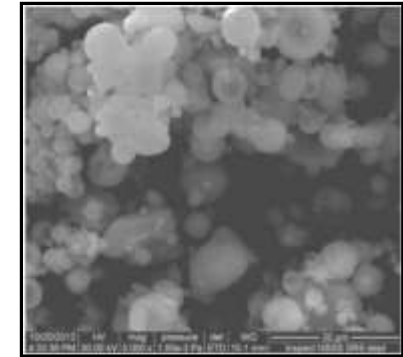
ACCELERATORS : To shorten the time of setting or increase the rate of hardening or strength development Ex: calcium chloride, Uses: Repair works, precast production, cold weather.

RETARDERS: To delay the setting time of cement Ex: soluble zinc salts gypsum, sugar, carbohydrate derivatives, lignosulphates. Uses: Hot weather.



Industrial byproducts

The ash produced at thermal power stations by burning of coal and lignite is known as fly ash. Fly ash and pulverized coal ash are the two names of the same thing. It is also known as pulverized fuel ash.



Advantages:-

- ✓ Fly ash by mixing efficiently with the concrete mix can replace Portland cement that in turn can aid in making big savings in concrete material prices.
- ✓ It is an environmentally-friendly solution.
- ✓ It improves the strength over time and offering greater strength to the building.
- ✓ Increased density and also the long-term strengthening action of flash that ties up with free lime and thus, results in lower bleed channels and also decreases the permeability.



Fly ash and pulverized coal ash

- ✓ The reduced permeability of concrete by using fly ash, also aids to keep aggressive composites on the surface where the damaging action is reduced. It is also highly resistant to attack by mild acid, water and sulfate.
- ✓ It effectively combines with alkalis from cement, which thereby prevents the destructive expansion.
- ✓ It is also helpful in reducing the heat of hydration. The pozzolanic reaction in between lime and fly ash will significantly generate less heat and thus, prevents thermal cracking.
- ✓ It chemically and effectively binds salts and free lime, which can create efflorescence. The lower permeability of fly ash concrete can efficiently reduce the effects of efflorescence.

Disadvantages:-

- ✓ Poor quality often has a negative impact on the concrete. It can increase the permeability, thus damaging the building.
- ✓ Some fly ash, those are produced in power plant are usually compatible with concrete, while some needs beneficiation. Thus, it is very much vital to use only high quality fly ash to prevent negative effects on the structure of the building.