Effect of time on Compressive strength of Cement Mortar

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Abstract- ***Mortar is a mixture of cement and sand in*** **some specified proportion which is generally used for brick masonry and plastering. In first case of the mortar compressive loads such as the load of the wall above it, therefore it is very much necessary to test the mortar for its compressive strength. Which is typically determined 7 to 28 days after the mortar was prepared and used in construction. This time lag creates problems. This paper discusses the variation of cement mortar compressive strength with time with the help of graphs plotted so that we can know the exact time interval within which the mortar should be used to avoid wastage of materials and avoid the unsuitability of material for the construction work.**

Index Terms- **Mortar, manufacturing, transportation, composition, strength of mortar, construction technology.**

I. INTRODUCTION

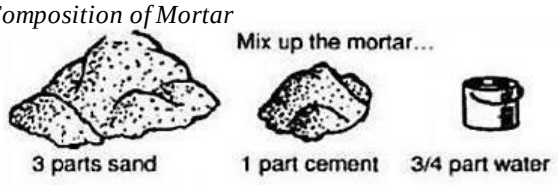
Mortar is a workable paste used to bind building blocks such as stones, bricks, and concrete masonry units together, fill and seal the irregular gaps between them, and sometimes add decorative colors and patterns in masonry wall.

It has four basic types. "Lean" mortar has a minimal amount of cement content while the "rich" type contains a high volume of cement. "Neat" cement, on the other hand, is pure cement, meaning it has no sand content. The "aggregate" type has coarser materials, usually gravel or fragmented rock.

Mortar serves many important functions:

- It bonds units together into an integral structural assembly.
- The seals joints against penetration by air and moisture.
- It accommodates small movements within a wall.
- Ties and anchors so that all elements perform as an assembly.

Composition of Mortar



Properties of a good mortar

- It should be capable of developing the designed stresses.
- It should be capable of resisting penetration of rain water.
- It should set quickly so that speed in construction may be achieved.
- It should not affect the durability of materials with which it comes into contact.

Four basic problems in compressive strength test provisions:

What is acceptable?

There is no pass/fail compressive strength value to determine if the mortar is acceptable. It is a simple task to prepare a mortar cube or cylinder and test it in compression and to report a compressive strength. ASTM intentionally does not include minimum compressive strengths for field sampled mortar in any standard.

Strengths should vary

Water to cement ratio is a critical factor affecting the strengths of cement-based materials. But, there is no need of any tight control of the water to cement ratio for quality control of masonry mortar. The mason is encouraged to add water as necessary to fit the conditions of the day. We should be more concerned if the tested mortar strengths do not change

throughout the course of the project. However, this means that the target strength changes.

Strengths are not representative

The manner by which compressive strengths are determined greatly underestimates the actual loadbearing capacity of the mortar in place. There are two primary reasons for this mischaracterization. The first is water to cement ratio. So, while a tested mortar may have a reported strength of 1000 psi, its actual loadbearing capacity may be 3000 to 5000 psi.

Timings

Compressive strengths are typically determined seven to 28 days after the mortar was prepared and used in construction. This time lag creates problems. So, this paper is made to show the variation of compressive strength of the mortar with time. Here, the comparison of the compressive strength variation using two cements has also been shown. This will be helpful to the workers and the engineer to prepare only that much amount of mortar at a time which will be sufficiently strong to provide the desirable properties during construction practices. It will also save the wastage of materials as well as labor cost

Literature review

Insufficient long-term durability of civil engineering infrastructure, especially concrete structures, has been a major problem causing enormous economic loss to many countries. Mortar works as a matrix in concrete. Factors affecting the strength of mortar are the cohesion of the cement paste and its adhesion to the aggregate properties. In regular Practice it is very difficult to prepare the plaster layer in wall monolithically due to location of plastering surface and bad workmanship for this study we visit more than three sites.

Plastering material consist of cement sand and water and we know the properties of cement as per IS Initial setting time and final setting time of cement and also compressive strength of cement for this experimental work. Here we prepare three type of cube of size 7.07x7.07x7.07 cm 1) Regular cement cube cast as per IS guide line 2) casting 50% Volume and remaining after one hour with cement slurry joint same material 3) casting the same material without joint.

This paper basically focuses on the effects of time laps and joint affects the compressive strength of cement. At issue is the reality that most who use compressive strength tests of mortar cubes as a means of assessing the character of the mortar are misusing or misinterpreting information. The result is a considerable waste of time and money for building owners, contractors and material suppliers to explain why the mortar is acceptable and appropriate despite what is the mortar strengths might suggest. During the time period of 28 days, the construction does not stop and it is costly to then make corrections if indeed a problem with the mortar does exist.

II. MANUFACTURE

Portland slag cement shall be manufactured either by intimately intergrinding a mixture of Portland cement clinker and granulated slag with addition of gypsum (natural or chemical) or calcium sulphate, or by an intimate and uniform blending of Portland cement and finely ground granulated slag, so that the resultant mixture would produce a cement capable of complying with this specification. No material shall be added other than gypsum (natural or chemical) or water or both. However, when gypsum is added it shall be in such amounts that the sulphur trioxide (SO3) in the cement produced does not exceed the limits. Besides, not more than one percent of air-entraining agents or surfactants which have proved not to be harmful, may be added.

The slag constituent shall be not less than 25 percent nor more than 70 percent of the Portland slag cement.

III. CHEMICAL REQUIREMENTS

Portland cement clinker used in the manufacture of Portland slag cement shall comply in all respects with the chemical requirements specified for the 33 grade ordinary Portland cement in IS 269 : 1989, and the purchaser shall have the right, if he so desires, to obtain samples of the clinker used in the manufacture of Portland slag cement.

Percent, Max	
Magnesium oxide (MgO)	10.10
Sulphur trioxide (SO_3)	3.0
Sulphide sulphur (S)	1.5
Loss on Ignition	5.0

Insoluble residue	4.0

IV. PHYSICAL REQUIREMENTS

Fineness

When tested for fineness in terms of specific surface by Blaine's Air permeability method described in IS 4031 (Part 2): 1988, the specific surface of slag cement shall be not less than 2250 m^2/kg.

Soundness

When tested by Le-Chatelier's method and autoclave test described in IS 4031 (Part 3):1988, unaerated Portland slag cement shall not have an expansion of more than 10 mm and 0.8 percent respectively. In the event of cements failing to comply with any one or both the requirements specified. The expansion of cements so aerated shall be not more than 5 mm and 0.6 percent when tested by Le-Chatelier's method and autoclave test respectively.

Setting Time

The setting time of slag cement, when tested by the Vicat's apparatus method described in 1S 4031 (Part 5) : 1988, shall be as follows:

a) Initial setting time Not less than 30 minutes
b) Final setting time Not more than 600 minutes

Compressive Strength

The average compressive strength of at least three mortar cubes (area of face 50 cm^2) composed of one part of cement, three parts of standard sand by mass and (P/4+3.0) percent (of combined mass of cement plus sand) water, and prepared, stored and tested in the manner described in IS 4031 (Part 6) : 1988, shall be as follows:

- 72 ± 1 h Not less than 16 MPa
- 168 ± 2 h Not less than 22 MPa
- 672 ± 4 h Not less than 33 MPa

V. STORAGE

The cement shall be stored in such a manner as to permit easy access for proper inspection and identification and in a suitable weather-tight building to protect the cement from dampness and to minimize warehouse deterioration.

VI. MANUFACTURER'S CERTIFICATION

The manufacturer shall satisfy himself that the cement conforms to the requirements of this standard, and if requested, shall furnish a certificate to this effect to the purchaser or his representative, within ten days of dispatch of cement.

The manufacturer shall furnish a certificate, within ten days of dispatch of the cement, indicating the total chloride content in percent by mass of cement.

VII. TRANSPORTATION

The cement shall be packed in bags [jute sacking bag conforming to IS 2580 : 1982, double hessian bituminized (CRI type), multiwall paper conforming to IS 11761 : 1986, polyethylene lined (CRI type) jute, light weight jute conforming to IS 12154 : 1987, woven HDPE conforming to IS 11652 : 1986, woven polypropylene conforming to IS 11653 : 1986, jute synthetic union conforming to IS 12174 : 1987 or any other approved composite bags] bearing the manufacturer's name or his registered trade-mark, if any. The words 'FOR EXPORT' and the net mass of cement per bag/drum shall be clearly marked in indelible ink on each bag/drum.

NOTE: A single bag or container containing 1 000 kg or more net mass of cement shall be considered as bulk supply of cement. Supplies of cement may also be made in intermediate containers, for example drums of 200 kg, by agreement between the purchaser and the manufacturer.

VIII. SAMPLING

Samples for Testing

A sample or samples for testing may be taken by the purchaser or his representative, or by any person appointed to superintend the work for the purpose of which the cement is required, or by the latter's representative. The samples shall be taken within three weeks of the delivery and all the tests shall be commenced within one week of sampling.

Facilities for Sampling and Identifying

The manufacturer or supplier shall afford every facility, and shall provide all labour and materials for taking and packing the samples for testing the cement and for subsequent identification of the cement sampled.

Sand:

Aggregate most· of which passes through 4.75 mm IS sieve is known as fin aggregate. Fine aggregate shall consist of natural sand, crushed stone sand or crushed gravel sand stone dust or marble dust,' fly ash and Surkhi (crushed brick and cinder) conforming to IS:2686-1977. It shall be hard, durable, chemically inert, clean and free from adherent coatings, organic matter etc.

Quality of sand:

The sand shall consist of natural sand, crushed stone sand or crushed gravel sand or a combination of any of these. The sand shall be hard, durable, clean and free from adherent coatings and organic matter.

Grading of sand:

On the basis of particle size, fine aggregate is graded into four zones. The grading when determined in accordance with the procedure. Where the grading falls outside the limits of any particular grading zone of sieves, other than 600 micron IS sieve, by a total amount not exceeding 5 percent, it shall be regarded as falling within that grading zone.

Some bad effects of water containing impurities are following:

Presence of salt in water such as Calcium Chloride, Iron Salts, inorganic salts and sodium etc. are so dangerous that they reduce initial strength of concrete and in some cases no strength can be achieved. There is rusting problem in steel provided in RCC.

Presence of acid, alkali, industrial waste, sanitary sewage and water with sugar also reduce the strength of concrete.

Presence of oil such as linseed oil, vegetable oil or mineral oil in water above 2 % reduces the strength of concrete up to 25 %.

Limit of Solids

Organic: 200 Mg per liter

Inorganic: 3000. Mg per liter

Sulphate: 400 mg per liter

Chloride: 500 mg per liter for RCC work and 2000 mg per liter for concrete not containing steel.

Various studies across the globe

Various studies have been done on compressive strength of cement mortar.

For example: Shaswat Mukharjee (2011) carried out an experimental investigation to study the effect of variation of compressive load on mortar specimens. Ordinary portland cement and river sand as fine aggregate was mixed with water/cement ratio of 0.45. Loads of 0, 30, 50 and 70% of compressive strength at 7 days were applied to the samples of age 7 days separately and released the load immediately. At higher loading range, cracks of up to 2 mm have been noticed on the surface of the samples.

Scope of study

The aim of this study is to determine the variation of compressive strength of cement mortar with time. In the real life problems, the laborers prepare a huge amount of mortar at a time to save the extra labor. But, as per the knowledge, the mortar strength is acceptable only till its final setting time. The required bonding (maximum) can be achieved if we use it within its initial setting time. After that, the strength starts reducing.

Experimental program

General

The details of various tests carried out on mortar samples and materials used for preparing mortar are discussed in this chapter. In the present work the effect of time on the strength and durability of mortar samples cured for a short period of time was studied. Compressive strength test was conducted on mortar cubes casted at an interval of 1, 2, 4, 6 hours.

Procedure:

Weigh a clean and dry specific gravity bottle with its stopper (W1).

Place a sample of cement up to half of the flask (about 50gm) and weigh with its stopper (W2).

Add kerosene (polar liquid) to cement in flask till it is about half full.

Mix thoroughly with glass rod to remove entrapped air.

Conclusions

- 28 days strength of mortars is average about 60% higher than 7 day strengths.
- Quantification of the change in strength characteristics due to casting of mortar cubes at different intervals of time after mixing was the main objective of the study. The compressive

strength of cement was tested as per IS 4031. Fig. 1 shows the effect of variation in time of casting on 7 day compressive strength of cement mortar cubes.

- After 8 hours of casting, the reduction is 35.54 % for Portland slag cement and 32.56 % for Portland pozzolana cement.

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