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EXPERIMENTAL STUDIES ON FIBER BASED CEMENT MORTAR CONTAINING FLYASH AND M-SAND

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Abstract- In this present experimental investigation, the influence of fly ash, M-sand and polypropylene fibers on strength and durability properties is investigated. About 20% of cement is replaced by fly ash, replacement of natural sand by M- sand in proportions of 50% and 100% and polypropylene fibers of dosage 3.6kg/m^3 is employed for 1:4 cement mortar mix. Strength and durability properties such as, acid resistivity (12% concentration H_2SO_4) and alkaline resistivity (12% concentration Na_2SO_4) were evaluated for all the mixes of cement mortar and pull off test is carried out.Thriveni M-sand (Plaster sand) is one of the alternative to fine aggregates in mortar. In present investigation compressive, flexure, tensile strength also durability of cement mortar is studied for 1:4 mortar mix with cubes, briquette samples and prisms tested at the age of 7,14 and 28 days. After 28 days of curing durability of all the cement mortar mixes is tested after exposing the samples for one month in acid and alkali solutions, in addition to pull off test on the plaster work is carried out after 28 days of curing in water for all the cement mortar mixes which is considered in this research work.

Index terms: : Pozzolanic,Mortars,Compressivestrength,Flexural strength,Durability

I. INTRODUCTION

Cement, sand and total are basic requirements for any development industry. Sand is a noteworthy material utilized for readiness of mortar and concrete and assumes a most vital job in blend outline. When all is said in done utilization of regular sand is high, because of the expansive utilization of cement and mortar. Henceforth the interest of regular sand is high in creating nations to fulfill the quick framework development. The creating nation like India confronting lack of good quality characteristic sand and especially in India, common sand stores are being spent and making genuine risk condition and also the general public. Fast extraction of sand from waterway bed causing such a significant number of issues like losing water holding soil strata, extending of the stream informal lodging bank slides, loss of vegetation on the bank of waterways, aggravates the sea-going life and in addition bothers farming because of bringing down the water table in the well and so forth are a portion of the models. Concrete is the most usually utilized material for development.

Designers have been searching for solid which is ever more grounded and more strong against forceful condition, Concrete structures might be presented to sulfate and chloride salts and different acids in light of the ecological contamination. Sulfates are found as Na+,Mg2+,Ca2+,NH4+ in the arrangements. The kind of activity of these salts on the solid changes.

Concrete presented to sulfate assault looses compressive quality and this misfortune increments as capacity of sulfate focus and time of introduction. Pozzolonas demonstrate diverse strength properties with the substance and sort of dynamic silica present in their structure. In connection to the impact of

pozzolona on solid quality, it ought to be expressed that compose, sum and fineness of pozzolona and furthermore the kind of bond are factors that influence the quality of cement.

Supplementary cementicius materials (SCM) are generally used to incompletely supplant bond in concrete. They are regularly added to cement to make the blends more practical, decrease penetrability, increment quality, or impact different properties.

Average models incorporate characteristic pozzolonas (like volcanic fiery debris), fly cinder, ground granulated impact heater slag, rice husk powder, and silica seethe. Pozzolonas respond artificially with calcium hydroxide (Ca(OH)2) from the hydration of Portland bond to frame calcium silicate hydrates or CSH. CSH is the solid cover that solidifies in concrete.

II. EXPERIMENTAL PROGRAMME

2.1 Basic Materials and Their Properties

The Indian Standard Specification for 43 Grade normal Portland concrete fitting in with IS 8112-1989, is utilized in the present work. The pozzolonaic material that is fly fiery debris is utilized as a substitution of 20% of concrete, half and 100% of stream sand is supplanted by Manufactured mortar sand additionally Recorn Polypropylene fiber of greatest measurement that is 3.6kg/m3 regarding volume of mortar, according to the detail is utilized. The water/bond proportion (w/c) of 0.5 is kept up steady all through the task for mortar blend proportion 1:4 extent by volume of materials is considered i.e, one a player in concrete and three piece of fine total.

Cement is a material that has firm and cement properties within the sight of water. Such bonds are called pressure driven concretes. These comprise basically of silicates and aluminates of lime acquired from limestone and mud.

Conventional port land bond (OPC) is the fundamental Portland bond and is most appropriate for use when all is said in done solid development. It is of three kinds, 33 review, 43 review, 53 review. One of the essential advantage is the quicker rate of improvement of quality.

In the experimentation 43 review conventional Portland concrete (Ultra tech mark) is utilized for all blends. The bond utilized is new and with no knots.

The testing of bond is done according to Seems to be: 8112-1989. Table 2.1 shows substance properties of the bond as given by the producer, and Table 2.2 demonstrates the Physical properties of 43 Grade OPC.

Table 1 : Chemical properties for 43 Grade OPC

Sl No	ChemicalConstituents	Oxide	Testedresults				
			FlyAsh*	RiceHusk	Silica Fumes**	Calcined Clay	Slag
1	Silica(%)	SiO_2	58.95	87.94	97.02	43	36
2	Alumina(%)	Al_2O_3	29.24	3.80	0.20	19.7	10
3	Ferricoxide(%)	Fe_2O_3	0.98	0.84	0.09	11.4	0.5
4	Magnesia(%)	MgO	1.05	1.05	0.04	2.20	0.44
5	Lime(%)	CaO	1.02	0.80	0.11	2.62	39

6	Alkalies(%)	Na_2O	0.24	…	0.28	2.51	…

Table 2 : Physical properties of 43 Grade OPC

Sl No.	Particulars	Requirement as per IS 8112:1989	Test results
1	Fineness Specific surface m^2/kg	225 (min)	310
2	Standard Consistency (%)	-	28.5
3	Setting time (min) Initial Final	 30 (min) 600 (max)	 220 295
4	Soundness Le- Chatelier (mm) Autoclave (%)	 10 (max) 0.8 (max)	 1.2 0.045
5	Compressive strength (N/mm^2) 72 ± 1h (3-days) 168 ± 2h (7-days) 672 ± 4h (28-days)	 23 (min) 33 (min) 43 (min)	 24.34 35.67 43.25

2.2 TESTING PROCEDURE.

1. The Compressive quality is dictated by testing the mortar blocks of size 70.6x70.6x70.6 mm for 7,14 and 28 long stretches of restoring,

2.The rigidity is controlled by testing the briquette tests which are relieved for 28 days.

3.The flexural quality is dictated by testing the crystal tests of size 40mmX40mmX160mm following 28 long stretches of relieving.

4.Durability of the distinctive blends is controlled by directing compressive quality test for three diverse submersion arrangement, for example, water, sodium sulfate and sulphuric corrosive arrangement with 12% in focus by volume regarding water, after the examples are relieved for 28 days. The qualities of these examples are assessed by compressive quality

5.Pull off test for various blend of mortar is dictated by testing 12mm thick mortar surface put on 100mm thick solid square which are restored for 28 days.

The Mortar Mix Designation are arranged in Table 3.

Table 3 : Mortar Mix Designation

Sl No.	Type designation	Type of material used	Mix Designation	Details of Fine aggregate	Description
1	CM	Cement	NS	i)100% Natural Sand	Cement mortar MIX
			MS1	ii)50% M Sand	
			MS2	iii)100% M sand	

2	FA	Fly ash	NS	i)100% Natural Sand	80%Cement + 20% Fly Ash
			MS1	ii)50% M Sand	
			MS2	iii)100% M sand	
3	PF	Polypropylene Fibers	NS	i)100% Natural Sand	3.6kg/m^3 of mortar
			MS1	ii)50% M Sand	
			MS2	iii)100% M sand	
4	FA+PF	Flyash and polypropylene fibers	NS	i)100% Natural Sand	80%Cement + 20% FA +3.6kg/m^3 PF
			MS1	ii)50% M Sand	
			MS2	iii)100% M sand	

III. RESULTS AND DISCUSSIONS

3.1COMPRESSIVE STRENGTH

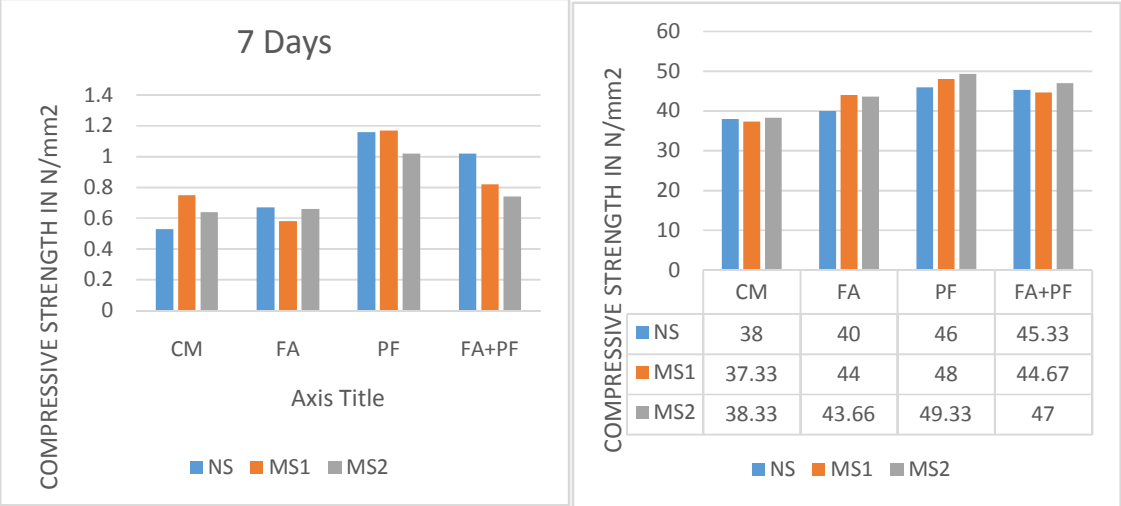

Figure 1 shows compressive strength test results of the mortar mixes at age of 7 and 28 days.

The Cement, polypropylene filaments, flyash and fine totals in 1:4 extents by volume is altogether dry blended to guarantee homogeneity. At that point, the deliberate amount of water is included and blended completely according to IS 4031-1985, promptly subsequent to blending, the oiled steel molds of standard size 70.6mmX70.6mmX70.6mm is filled in two equivalent layers and compacted utilizing compacting bar as appeared . Following 24 hours, the 3D shapes are demoulded and relieved in water for 7days, 28days of testing as appeared.

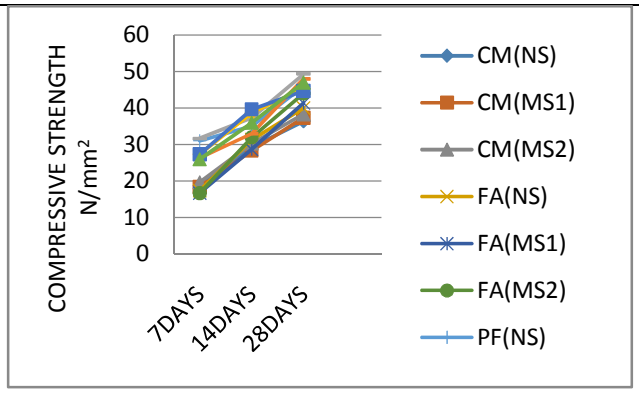

Figure 2 : Compressive strength of all the mortar mixes at 7,14 and28 days

3.2 TENSILE STRENGTH

The tensile specimens are prepared according to IS 4031- 1985 standard specification. The Cement, polypropylene fibers, flyash and fine aggregates in 1:4 proportions by weight is thoroughly dry mixed to ensure homogeneity. Then, the measured quantity of water is added and mixed thoroughly as per IS 4031-1985, immediately after mixing, the oiled briquette moulds of 25mm thickness is filled
smooth finished by blade of trowel as shown , and kept for 24 hours in normal atmosphere. After 24 hours, the specimens are demoulded as shown and cured in water for 28 days before testing as shown

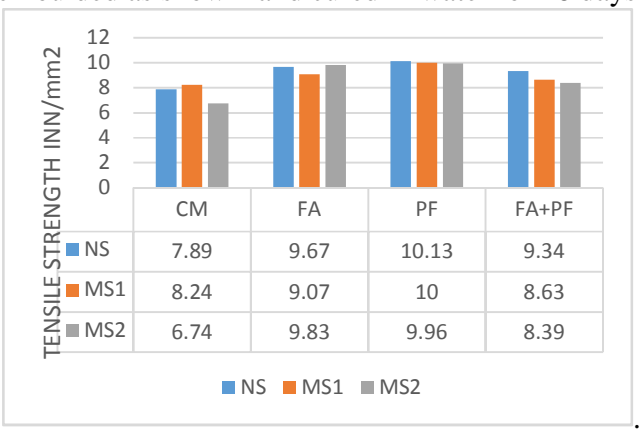

Figure 3 : Tensile strength of investigated mixes for the age of 28 days

3.3 FLEXURAL STRENGTH

Flexural strength is determined for all the investigated mixes by using prisms of dimensions (40mmX40mmX16mm) tested after 28 days of curing in water. The flexural specimens are prepared according to IS 1727-1967.Figure 4 shows the comparative Flexural strength results of the Investigated Mortar Mixes at age of 28 days.

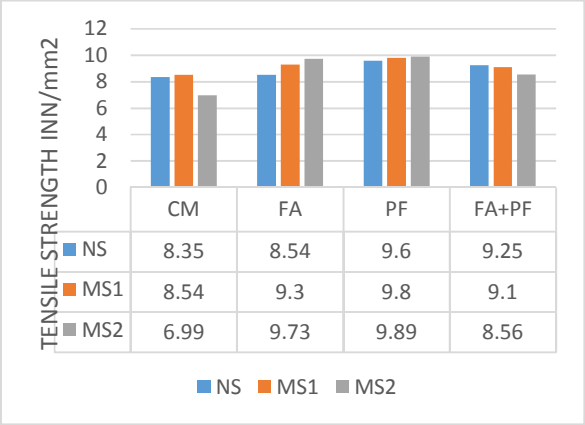

Figure 4: Flexural strength of investigated mixes for the age of 28 days

3.4 DURABILITY STUDY

The specimens cast for compressive strength test were exposed to water, solutions of 12% sodium sulphate(Na_2SO_4) and 12% sulphuric acid (H_2SO_4), tested at age of one month after 28 days of curing in water. Following table tabulates the compressive strength test results for all the mortar mixes with NS,MS1 and MS2, Immersed in 12% concentration of H_2SO_4 for one month after 28 days of curing.Following table 4.7 and 4.8 tabulates the compressive strength test results for all the mortar mixes with NS,MS1 and MS2, Immersed in 12% concentration of Na_2SO_4 for one and three months after 28 days of curing.

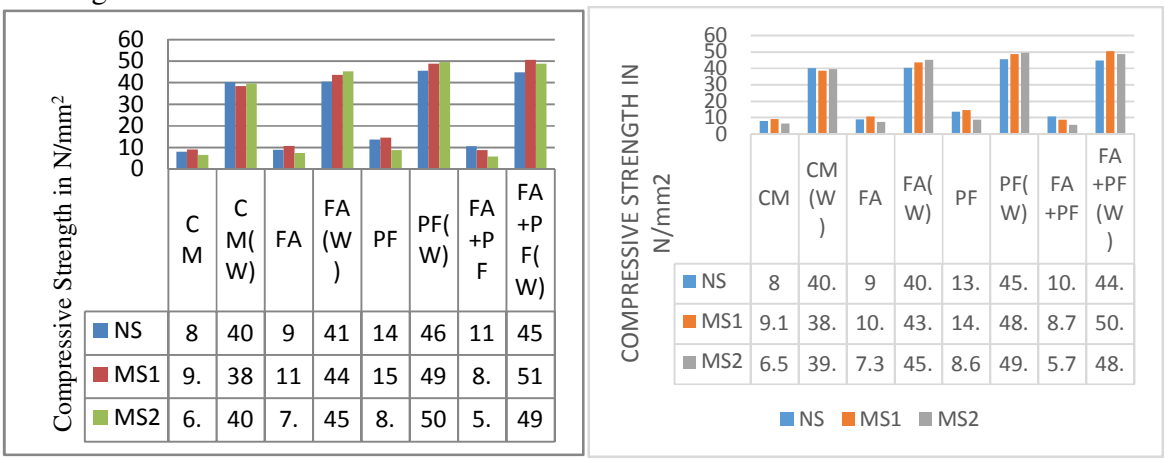

Figure 5: Compressive strength of investigated mixes after 1 and 3 months of acid curing.

COMPARISION OF COMPRESSIVE STRENGTH BETWEEN THE SAMPLES EXPOSED TO ACID SOLUTION FOR 1 AND 3 MONTHS AND SAMPLES CURED IN WATER FOR 28 DAYS.

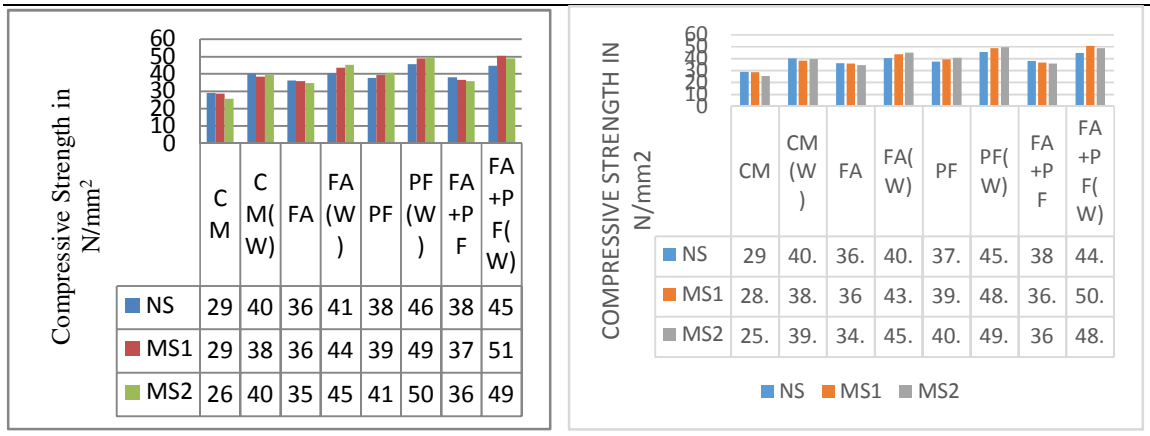

Figure 6: Compressive strength of investigated mixes after 1 and 3 months of alkali curing

COMPARISION OF COMPRESSIVE STRENGTH BETWEEN THE SAMPLES EXPOSED TO ALKALINE SOLUTION FOR 1 AND 3 MONTHS AND SAMPLES CURED IN WATER FOR 28 DAYS.

3.5 PULL OFF TEST

The bond strength test evaluate in place the adhesion strength between a concrete substrate and an applied overlay. The test utilizes 50mm diameter steel disc (dolly), 30mm high is glued on the grooved surface as shown.

Test procedures are as follows:

1. The plate is stuck on a dry, perfect and plane surface with a super paste creating a solid contact between the circle and notched surface.
2. The centerline of the plate agree with centerline of mostly bored center inside the resistance of 0.25mm.
3. The center will be bored splendidly straight and opposite to the surface.
4. A screw is screwed on the plate and the draw off analyzer (Dyna Z) is mounted on it. The computerized machine begins to pull the penetrated surface with a uniform stacking of 3seconds/kN.
5. The load at which bored surface falls off is recorded in kN.

The aftereffect of bond quality test is organized under the table 4.8.

There are two types of failure in pull off test, one is plaster failure and the other one is bond failure. In this study all the failure of plastered cement mortar for all the mixes are bond failure.

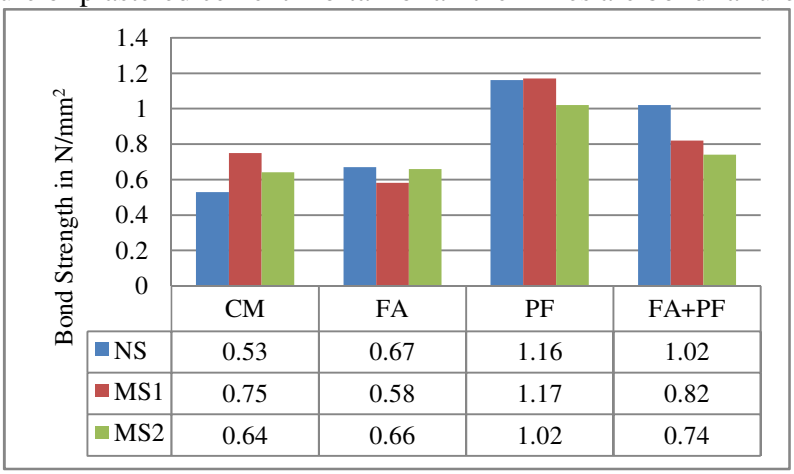

Figure 7 : Comparison between Adhesive / Bond strength between the specimens containing NS, 50% M Sand and MS2 (After 28days curing)

In this present test examination, the impact of fly cinder, M-sand and polypropylene filaments on quality and strength properties is explored. Around 20% of bond is supplanted by fly cinder, substitution of regular sand by M-sand in extents of half and 100% notwithstanding polypropylene filaments of measurement 3.6kg/m3 is utilized for 1:4 concrete mortar blend. Quality and solidness properties, for example, corrosive resistivity (12% fixation H2SO4) and basic resistivity (12% focus Na2SO4) were assessed for all the blends of concrete mortar and haul off test is done. The accompanying ends is drawn by contrasting the MS1 and MS2 blends and NS blend likewise all the mortar blends are contrasted with deference with CM blend.

IV. Conclusions

The following are the conclusions drawn from the investigation.

1) There in an increase in compressive strength of all the mortar mixes with 20% replacement of cement with pozzolanic material when compared to control mortar.

2) There in increase in flexural strength of all the mortar mixes with 20% replacement of cement with pozzolanic material when compared to control mortar.

3) It was observed that the compressive strength of all the mortar mixes with 20% replacementofcement with pozzolanic material were higher, when compared to compressive strength of control mortar for immersion in water, immersion in 20% sodium sulphuric acid solution and 12% sodium sulfate solution indicating better durability of various mortar mixes compared to control mortar. sulphuric acid (H2SO4) has a more severe effect on the durability than with that of compared with that of sodium sulfate (Na2SO4) solution.

4) The addition of 20% of pozzolanic material to mortar mixes have shown that pozzolanic material has a potential in addition to various mortars as cement replacement materials from point of view of strength, durability and sustainability aspects.

5) It was found that the silica fume was the best among all the pozzolanic material with 20% replacement for cement to mortar mixes, as it has significantly improved the propertiesof the mortar such as compressive strength, flexural strength, and durability.

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