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Analysis Of Various Cementitious Materials And Combinations For The Development Of Ternary Cement Concrete

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Abstract: There has been significant expansion and new innovation in the building business over the last few decades, which has expanded the use of cement as a key material in concrete. The world environment is currently facing enormous problems as a result of greenhouse gases and other key factors.Carbon dioxide is the most common greenhouse gas, and it is produced by a variety of sources, the most significant of which being the cement industry, where carbon monoxide (CO) and carbon dioxide (CO^2) are produced on a huge scale. To decrease the dangers' consequences on the planet, we must implement eco-friendly sustainable development. As a result, in the building industry, the usage of cement in concrete has been reduced or replaced with more efficient cementitious materials such as Metakolin (MK), Fly Ash(FA).

Index Terms **- Metakolin(MK),Fly Ash(FA)**

[1]INTRODUCTION

Concrete is largely used in construction as building material all over the world. Concrete is incomplete without a binding material such as cement and it has been modified to fulfill the needs of the construction sector. But while manufacturing of cement carbon monoxide and carbon dioxide generated on a large scale. Carbon dioxide subsidizes around 65% to a dangerous atmospheric deviation. The concrete business is answerable for around 6% of all CO_2 discharges, in light of the fact that the development of one ton of Portland concrete transmits roughly 0.9 tons of CO_2 into the climate[1][5]. For the construction activity Portland is the must and no any other solution up still not found. Portland is having the binding properties due to which it can bind the all the material as concrete work as a gravity and solid massive concrete. Researchers are working to increase its performance through the use of novel chemical admixtures and supplementary cementitious materials (SCMs). The fundamental advantage of SCMs is their ability to replace a specific amount of cement without diminishing the cementi-tious property.

[2]Material and Methodology

The material used for the experimentation includes the fly ash, metakaolin. The concrete was prepared by adding the various proportion of fly ash and metakaolin. To check the workability of the concrete in a proper proportion fly ash and metakaolin were added like 5 %, 10%, 15 %, and 20 %. From the test binding property of mix were tested. Water cement ratio kept 0.35 for all the experimentation. To gain the maximum compressive strength curing of prepared concrete block were carried out after 28 days. Basically, ternary blended cement means three type of material were added in the preparation of concrete.

The materials used are:
1.Cement
2.Fly Ash
3.Metakaolin
4.Water
5.Fine aggregates
6.Coarse aggregates

1.Cement

Basically, cement is the binding element which can bind the all the material properly and increase the strength of the concrete. Cement having 100 % compressive strength but having only 10 % tensile strength. To increase tensile strength, it is essential to add some material which can gain the strength. Cement consists of four main constitution such as tri calcium silicate, tricalcium aluminate, dicalcium silicate, and tetra calcium alumina calcium alumina ferrite which gives the mass solid strength to the concrete. For experiment 53 grade Ultra-Tech Cement used.

2.Fly Ash

The Fly ash particles are circular in shape and range from 0.5micron to 100 microns. It contains for the most part Silicon dioxide (SiO_2) in two structures glasslike and undefined (both smooth and adjusted), pointed and dangerous. Fly debris is by and large heterogeneous, comprising of a combination of smooth particles such as Quartz, Mullite, and Iron oxide. It contains poisons in critical sum. Silicon dioxide (SiO_2) both in glasslike structure and nebulous structure and Calcium oxide (CaO) are found in fly debris.

3.Metakaolin

Metakaolin is utilized in extraordinary applications where exceptionally low penetrability or extremely high strength is required. In these applications, metakaolin is involved more as an added substance to the substantial as opposed to a substitution of concrete commonplace options are around 10% of the concrete mass.Regular pozzolans are arranged by ASTM C 618 (AASHTO M 295) as Class N pozzolans ACI 232 (2000) gives a survey of normal pozzolans Metakaolin has delegated another age of valuable cementitious material.

4. Aggregates

The aggregates were chosen based on the BS 881 and 882 limitations. Natural river sand wasused as the sand, while crushed granite in sizes of 12.5 mm and 20 mm was employed as the aggregate. To manage the water content in the concrete, these components will be dried for 24 hours at 104°C.

[3]Preparing Test Cubes

The cubes were made in a mould that measured 150 x 150 x 150 mm. Each concrete mix consisted of twelve cubes. The concrete was poured in two stages into the mould, with each layer compressed with a steel bar. After 24 hours, the cubes were removed from the moulds and cured in sacks at room temperature.

1.Compressive strength test (IS-516-1959)

Concrete cubes of 150mm*150mm*150mm have been made. The cubes were mechanically vibrated during casting using a table vibrator. After 24 hrs, the specimens were demoulded and cured in portable water for 28 days. Following curing, the specimens were tested for compressive strength using a compression testing machine with a capacity of 2000KN. The maximum load at failure was established. The equation below was used to compute the average compressive strength of concrete specimens.

$$\text{Compressive Strength } (N/mm^2) = \frac{P\ (KN)}{\text{Area } (mm^2)}$$

Where P = Ultimate Compressive load
A= Cross Sectional Area of the Specimen

The tests were carried out on a set of triplicate specimens and the average compressive strength values were taken.

2.Split tensile strength test(IS -5816-1999)

Metakaolin and fly ash were used as partial replacement cement in the casting of concrete cylinders with a diameter of 150 mm and a length of 300 mm. A table vibrator was used to mechanically vibrate the cylinders during casting. After 24 hours, the specimens were demoulded and cured in portable water for 28 days. The cylindrical specimens were evaluated for split tensile strength after curing using a compression testing equipment with a capacity of 2000kN. The average split tensile strength was estimated using the equation once the ultimate load was determined.

Fig. Split Tensile Strength Test

$$\text{Split Tensile Strength } \left(\frac{N}{mm^2}\right) = \frac{2P}{ld}$$

where

P= Ultimate load in (N),

l=Length of cylindrical specimen in (mm),

d=Diameter of cylindrical specimen in (mm).

3 Flexural Strength Test (IS-516-1959)

A standard cylinder size of 100 mm x 100 mm x 500 mm was casted for the flexure test. All specimens are tested in the Universal Testing Machine using two-point stacking.

[4]Result

This chapter gives the basic information of results obtained in the experimentation. The fly ash, and metakaolin replace the cement in combination are discussed in comparison with those of normal concrete. To carry out the test concrete cubes are casted and kept for curing for 3 days, 7 days, and 28 days. After the proper curing compressive strength of the cube were carried out.

Table No.1. Results of Compressive strength , Split tensile strength &Flexural Strength for Ternary mix replacements

Sr.No	Replacement levels (%)		Compressive Strength (MPa)			Split Tensile Strength(MPa)	Flexural Strength in N/mm2
	Fly Ash for Cement	Metakaolin for cement	3 days	7 days	28 days	28 days	28 days
1.	0	0	25.68	35.59	45.69	4.63	6.52
2.	5	5	25.78	34.45	41.78	3.91	5.89
3.	5	10	26.01	35.34	44.11	4.15	5.34
4.	5	15	25.89	37.98	50.21	4.89	5.22
5.	5	20	25.43	35.85	46.12	5.33	4.92
6.	10	5	24.25	34.61	43.38	5.44	5.91
7.	10	10	24.89	34.45	44.89	4.91	5.66
8	10	15	25.92	34.97	43.78	5.68	5.32
9	10	20	23.78	31.78	41.11	5.25	4.89

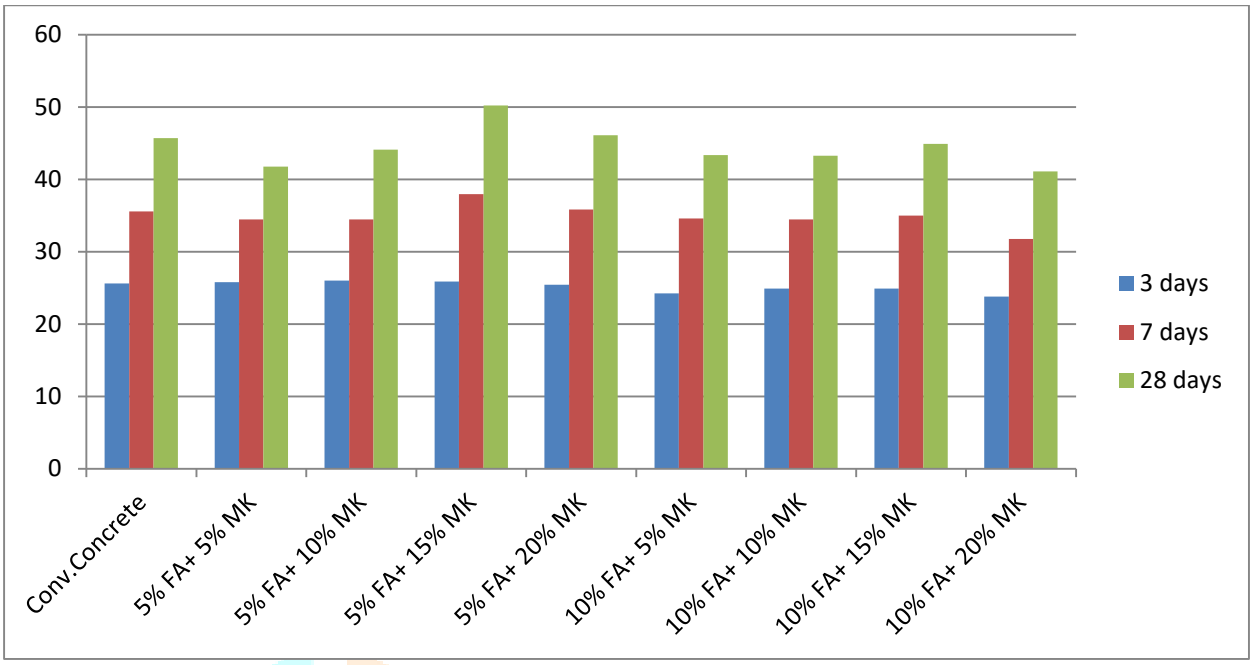
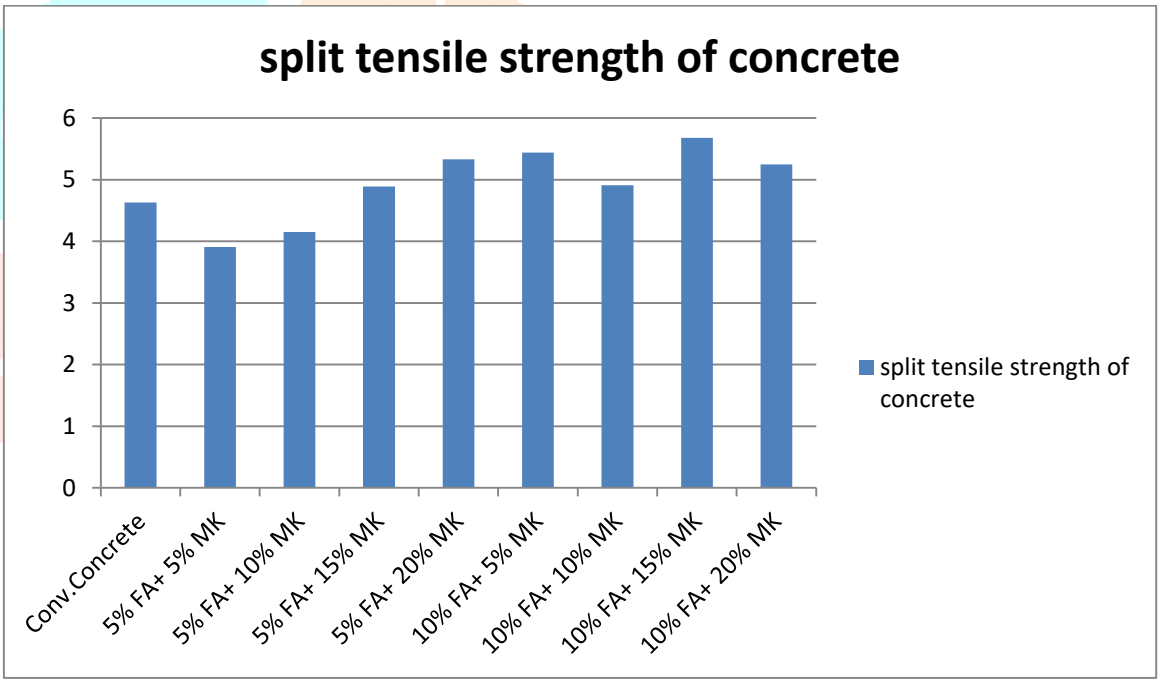
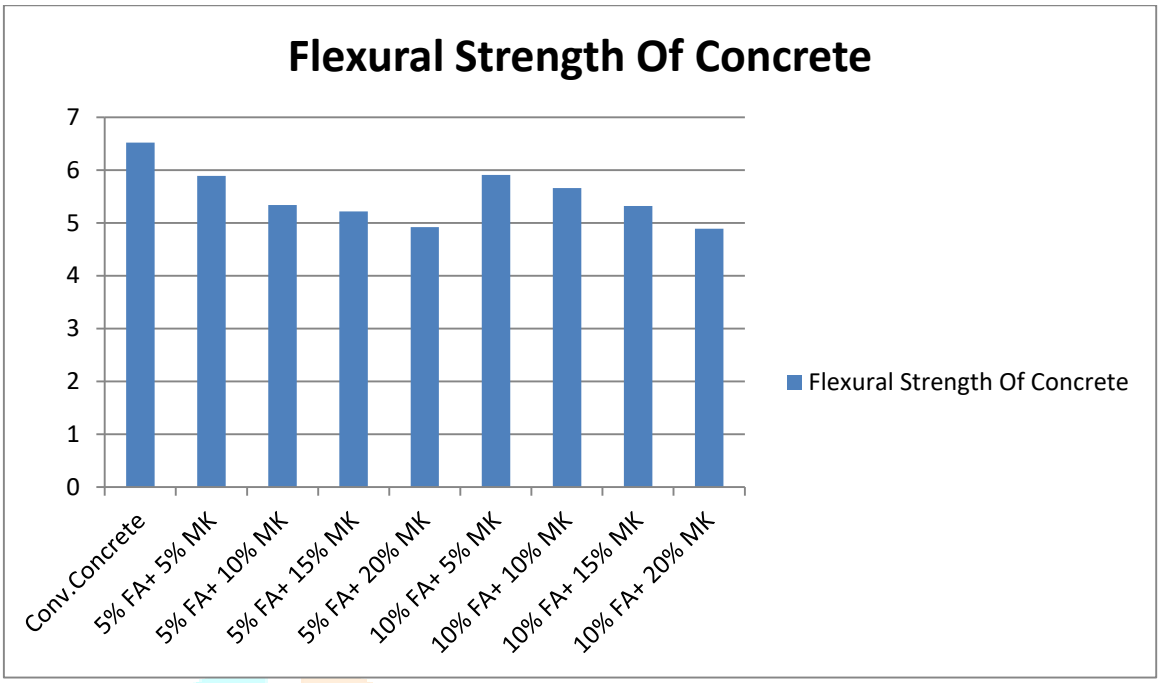


Fig. Compressive Strength Of Concrete





[4]CONCLUSIONS

The conclusion was carried out on the basis of experimental work, and actual result finding. It is found that the effect of metakaolin and fly ash is occurred on the strength of the concrete. The strength of the concrete was increasing due to addition of the metakaolin and fly ash.

By the addition of optimum quantity of Metakaolin with fly ash in the preparation of concrete block the strength of concrete going to be enhanced remarkable increased.

For Compressive Strength, Split tensile strength, Ternary blended concrete

From the result obtained we conclude that due to increasing percentage of metakaolin with fly ash compressive strength of concrete of Ternary mix 15%MK+5%FA shows higher value Of 50.21 N/mm2 as compared to Conventional concrete Value of 45.59N/mm2 While 10%FA+20%MK Shows lower value of compressive strength of 41.11N/mm2 as compared to P.C.C Value of 45.59N/mm2.

According to the above summary, increasing the amount of metakaolin with fly ash raises the compressive strength above the target mean strength, implying that the optimal combination of fly ash and metakaolin influence on concrete strength.

It is clear that mixture of 5% FA and 20% MK may increase strength while also making substantial more serviceable.

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