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Impact of Silica Fumes & Fly ash including Coir Fibre with Admixture on Compressive Strength of Grade M-30 Concrete Mix

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Abstract: ***There are so many modern construction materials (MCM) have been used in civil engineering construction based on their physical, chemical and mechanical properties. In this research paper modern construction materials have been used in the form of powder and ash included with fibres produced from industrial wastes and from agricultural wastes. In this regard, basic construction materials without them nothing can be started to construct but now-a-days these all are like cement, sand and aggregates are very costly materials so they may be partially replaced by percentage wise using industrial and agricultural waste materials for economical development and for the growth of the country. In this paper a research has been developed by doing an experimental analysis on mechanical properties concrete i.e. Compressive strength of cubes and Flexural strength of beams have been found out by using silica fume & fly ash as a partial replacement material of cement in concrete including coconut fibre & including admixture which have not been observed and determined in past till now. Admixture is added to increase the setting time of cement, workability of concrete and to improve the compressive and flexural strength of concrete. Grade of concrete has been kept constant as M-30 in all such kind of experimental research work. It is found that compressive strength has been increased by using silica fume including coir fibre with Admixture as compared to Fly Ash including coir fibre with admixture.***

Keywords*: Silica Fume, Fly Ash, Coir Fibre, Admixture, Compressive Strength, Concrete Mix*

I. INTRODUCTION

In a fast developing country where almost each and every day construction activities takes place in a modern sense to improve the structural strength with economic value, uses of prior modern materials are required. Concrete can bear up the severest environmental conditions; however, in several conditions it may show very low characteristics. Hence, engineers worldwide are constantly trying to improve its characteristics with the aid of modern admixtures and waste materials, usually called as alternate building materials (ABM). In this regard, basic construction materials without them nothing can be started to construct but now-a-days these all are like cement, sand and aggregates are very costly materials so they may be partially replaced by percentage wise using industrial and agricultural waste materials for economical development and for the growth of the country. The special characteristics of silica fume viz., super fineness, high silica content gave the scope for enhancing the normal cement concrete when mixed with cement as a partial replacement. Fly ash (FA) is a fine powder which is a by product from burning pulverized coal in electric generation power plants. Fly ash is a pozzolanic, a material containing aluminous and siliceous material that forms cement in the presence of water. Rising rate of steel day by day is the main problem in construction of new building. As an alternate solution of this problem, I use coconut fibre in place of steel which is quite economical, easy available and have desirable strength. Coir fibre is a reinforced fibre which gives durability and strength to concrete and also improves workability of concrete. Admixture is added to increase the setting time of cement, workability of concrete and to improve the compressive and flexural strength of concrete. Grade of concrete has been kept constant as M-30 in all such kind of experimental research work.

V. M. Malhotra and G. G. Carette (1983) Silica fumes, a by-product in the manufacture of Ferro-silicon and silicon metal, is a very efficient pozzolanic material. This paper describes its physical, chemical, and pozzolanic properties and its applications and limitations in concrete. it is recommended that it be used judiciously to solve specific problems and to make specialized products. Its indiscriminate use in concrete is not recommended. Pravin V Domke (2012), this paper describes about the results obtained from the detailed investigation done on the partial replacement of cement with RHA cement concrete and shows clearly up to how much percentage the cement can be replaced by RHA and COIR. Higher compressive strength obtained at the mix proportion of 12.5%Rha+2%COIR. At 2% and 3% COIR fiber gives maximum compressive strength. After addition of COIR fibers compressive

strength increased up to 3%-4%. Saurabh Samander etal (2013), this investigation is done to study of the effect of silica fume on fly ash cement bricks. The fly ash cement - bricks are tested after 7 days, 14 days and 28 days curing in concrete material testing laboratory of the institute. The experimental results showed that in the compressive strength of fly ash cement brick decreases with increase in content of silica fumes as replacement of cement whereas increases with increase in content of silica fume as addition. Shubha Khatri (2014) investigated that the compressive strength of concrete cubes for M-20 and M-40 grade concrete mix design by doing an experimental study by using Coconut Fibre and Polypropylene Woven Fibre (PPWF) including Admixture in the form of Super-plasticizer as CONPLAST (G-8) 410. Results show that compressive strength of concrete cube increases with admixture. Another study with Coconut fibre and PPWF including admixture also proves that compressive strength of concrete cubes increases much more as compared to with and without admixture-concrete cubes. Bhupendra Kumar, Dr. S S Kuswah and Dr. Amit Vishwakarma (2015), this research paper discusses the comparative study between coconut fiber concrete with plain cement concrete of M40 grade. This research paper deals use of the agricultural waste material into concrete, which enhanced the properties of concrete and makes environment ecofriendly. Anoopsingh Chandel etal (2016), this paper presents an experimental study of coir fibre reinforced concrete and its strength comparison with plain cement concrete. The compressive strength of Coir fibre reinforced concrete (CFRC) is nearly 13% more than that of a Plain cement concrete (PCC). 2. The tensile strength of CRFC is nearly 40% more than the PCC. Shubha Khatri & Priyanka Kumari (2017), investigated about compressive strength of concrete cubes with and without reinforcement by using waste agricultural materials in the form of wheat husk and rice husk ash as a partial replacement of cement for M-20 grade concrete and it was found out that wheat husk ash gives lower strength as compare to rice husk ash on 7 and 28 days respectively. Anshul Jain & Shubha Khatri (2017), did an experimental analysis on the mechanical properties of concrete using fly ash as a partial replacement material of cement with polypropylene woven fiber including admixture and it was found out that with 30 % added fly ash as a partial replacement of cement gives higher compressive strength and flexural strength as compare to 10 and 20% fly ash replacement.

II. METHODOLOGY

In this paper an experimental analysis has been carried out in laboratory with respect to initial and final setting time of cement, workability of concrete by slump cone test and then by compaction factor test to find out the properties of cement and concrete. To find out the compressive strength of concrete cubes mould size is taken 150mm by 150mm and grade of concrete is M-30. Silica fumes & Fly ash as a partial replacement material of cement have been uses in concrete. Coir fibres as a reinforcing material and admixture in the form of super-plasticizer have been used by weight of cement and they are added to the mix. Cubes are prepared for 7 and 28 days. Here percentages of silica fume & fly ash have been used from 10% & 20% respectively for 5%-10% coir fibre including 5%admixture. First of all normal concrete mix designed concrete cubes are moulded with 0% silica fume & fly ash and without coir fibre & admixture for 7 and 28 days and compressive strength has been checked. Then again concrete cubes with 0% silica fume & fly ash but with 5% and 10% coir fibre including 5%Admixture have been moulded for 7 and 28 days to check the compressive strength. Then again this procedure was repeated for 10%-20% silica fumes and fly ash as a partial replacement of cement with 5%-10% coir fibre including 5% admixture. Then compressive strength for this entire procedure has been checked.

III.EXPERIMENTAL ANALYSIS

As per above discussions observation tables are presented here. Following are values are obtained according to experimental analysis. Table 1 and Table 2 show the slump and compaction factor according to water/cement ratio with different amount of silica fumes & fly ash with coir fibre including admixture. In this table water-cement ratio has been kept as 0.45 and silica fume and fly ash as a partial replacement of cement have been used as 10%-20% by weight of cement. Percentage of coir fibre is kept as 5%-10% including 5% admixtures in form of super-plasticizer as a water reducing agent for concrete mix design for M-30 grade.

TABLE I

DETAILS OF SLUMP & COMPACTION FACTOR WITH SILICA FUMES AS A PARTIAL REPLACEMENT OF CEMENT WITH COIR FIBRE AND ADMIXTURE

S. No.	w/c Ratio	Silica Fume	Coir Fibre + Admixture	SLUMP (mm)	Compaction Factor
1	0.45	10%	5%Coir fiber+5%Admix	120	0.85
			10%Coir fibre+ 5% Admix	115	0.85

2	0.45	20%	5%Coir fiber+5%Admix	110	0.9
			10%Coir fibre+ 5% Admix	105	0.9

TABLE III
DETAILS OF SLUMP & COMPACTION FACTOR WITH FLY ASH AS A PARTIAL REPLACEMENT OF CEMENT WITH COIR FIBRE AND ADMIXTURE

S. No.	w/c Ratio	Fly Ash	Coir Fibre + Admixture	SLUMP (mm)	Compaction Factor
1	0.45	10%	5%Coir fiber+5%Admix	116	0.80
			10%Coir fibre+ 5% Admix	112	0.80
2	0.45	20%	5%Coir fiber+5%Admix	105	0.85
			10%Coir fibre+ 5% Admix	100	0.85

Table 1 shows the experimental results related to slump cone test for workability of concrete mix with silica fume 10% and 20% replaced by cement with coir fibre and admixture additive materials. Similarly Table 2 shows the experimental results related to slump cone test for workability of concrete mix with fly ash 10% and 20% replaced by cement with coir fibre and admixture additive materials. Slump decreases with workability increases. In the mean time compaction factor is also observed.

TABLE IIIII
COMPRESSIVE STRENGTH TEST OF CONCRETE CUBES OF SIZE 150MM×150MM×150MM FOR 7 AND 28 DAYS CURING WITH COIR FIBER AND ADMIXTURE AT DIFFERENT CONTENT AND SILICA FUME AS A PARTIAL REPLACEMENT OF CEMENT WITH 10% AND 20% BY WEIGHT OF CEMENT

S. No.	Silica Fume % (replacement by wt. of cement)	Coir Fibre %+ Admixture % (By weight of cement)	Compressive Strength of Cubes N/mm^2	
			7Days	*28 Days*
1	0% (Control Concrete)	0% Coir fiber+0% Admix	20.1	30.3
2	0%	5% Coir fibre +5% Admix	20.5	30.5
		10% Coir fibre + 5% Admix	22.3	32.7
3	10%	5% Coir fibre +5% Admix	25.2	36.3
		10% Coir fibre + 5% Admix	35.0	45.0
4	20 %	5% Coir fibre +5% Admix	37.5	47.5
		10% Coir fibre + 5% Admix	47.3	57.8

Fig 1 Concrete Mix

Table 3 shows the experimental results related to compressive strength test with silica fume 10% and 20% replaced by cement with coir fibre as 5% and 10% including admixture as an additive material by percentage weight of cement for water-cement ratio as 0.45 for concrete mix design M-30 grade. Similarly, Table 4 shows the experimental results related to compressive strength test with fly ash 10% and 20% replaced by cement with coir fibre as 5% and 10% including admixture as an additive material by percentage weight of cement for water-cement ratio as 0.45 for concrete mix design M-30 grade.

TABLE IVV

COMPRESSIVE STRENGTH TEST OF CONCRETE CUBES OF SIZE 150MM×150MM×150MM FOR 7 AND 28 DAYS CURING WITH COIR FIBER AND ADMIXTURE AT DIFFERENT CONTENT AND FLY ASH AS A PARTIAL REPLACEMENT OF CEMENT WITH 10% AND 20% BY WEIGHT OF CEMENT

S. No.	Fly Ash % (replacement by wt. of cement)	Coir Fibre %+ Admixture % (By weight of cement)	Compressive Strength of Cubes N/mm^2	
			7Days	*28 Days*
1	0% (Control Concrete)	0% Coir fiber+0% Admix	20.1	30.3
2	0%	5% Coir fibre +5% Admix	20.5	30.5
		10% Coir fibre + 5% Admix	22.3	32.7
3	10%	5% Coir fibre +5% Admix	23.5	34.0
		10% Coir fibre + 5% Admix	32.3	41.5
4	20 %	5% Coir fibre +5% Admix	34.5	43.2
		10% Coir fibre + 5% Admix	42.0	52.11

IV. RESULTS & DISCUSSIONS

After conducting experimental analysis results are plotted in excel sheet and discussions have been made.

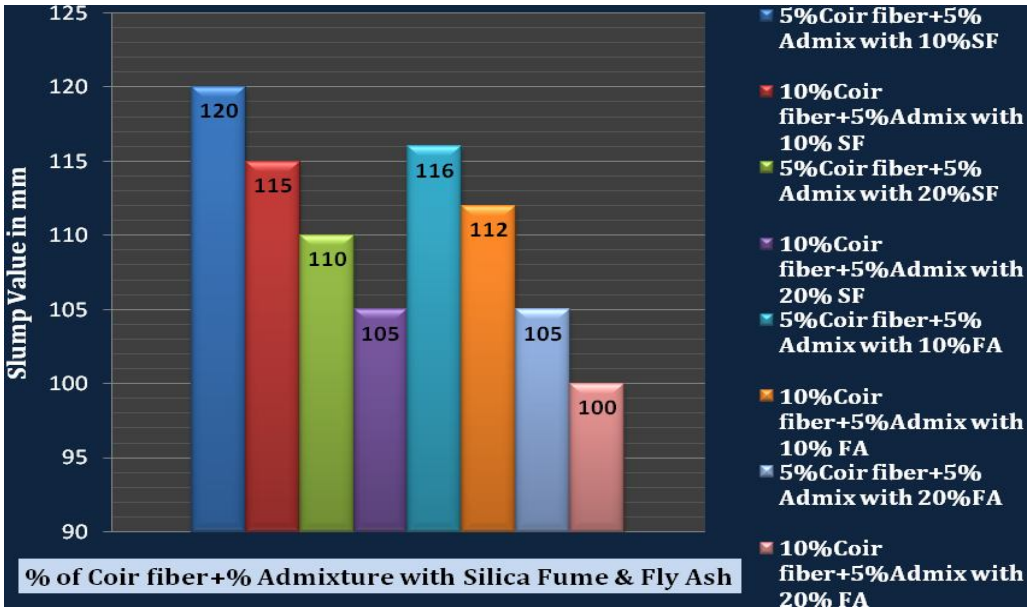

Fig 2 Workability Analysis of M-30 grade concrete mix with different percentage of Silica fume-Fly ash-Coir Fibre+ Admixture

As shown in figure 2 that by increasing the amount of silica fume (SF) from 10% to 20% with inclusion of 5% and 10% Coir Fiber (CF) plus 5% Admixture slump value is decreasing continuously. In the mean time it is also noticed that compaction factor has been increased because workability is directly connected to compaction factor. Workability has been increased by increasing the amount of silica fume while slump value has been decreased. Coir Fiber including percentage of admixture by weight of cement has been mixed in concrete for M-30 grade so by increasing these amounts with different percentage of silica fume slump value is decreased. For 5% Coir Fiber+5% ADMIX with 10% SF slump value is 120mm & for 10% Coir Fiber + 5% ADMIX with 10% SF it is 115mm. Similarly, for 10% Coir Fiber + 5% ADMIX with 20% SF it is 110mm & for 10% Coir Fiber +5% ADMIX with 20% SF it is 105mm.

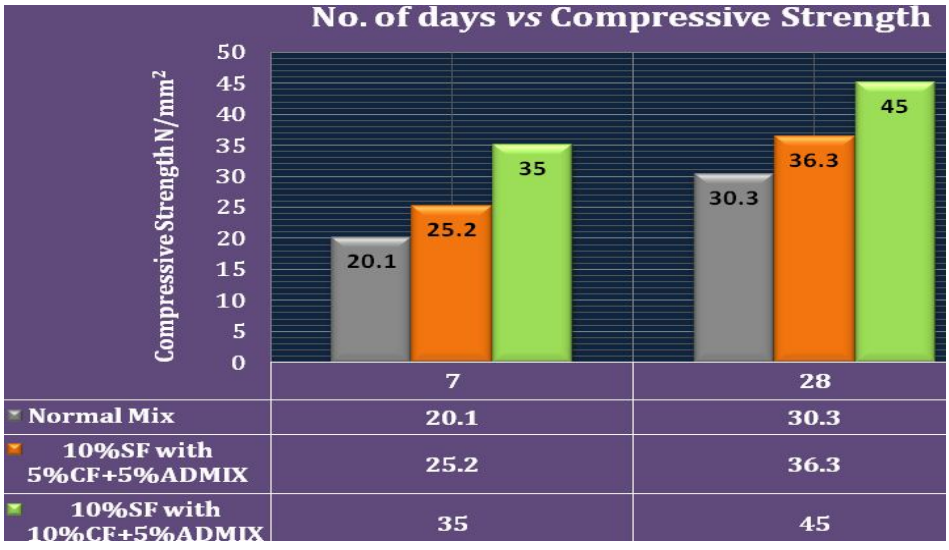

Fig 3 Compressive Strength of Concrete Cubes with: 5% & 10 % of CF+5%Admixture with 10 % Silica Fume

In above figure 3 a graph has been plotted between 5% CF + 5% Admixture & 10% CF + 5% Admixture with 10% SILICA FUME as a partial replacement of cement. For normal mix concrete values are already determined like 20.1 N/mm2 and 30.3 N/mm2 for 7 and 28 days respectively. Now for 5% CF+5%Admixture and 10%CF+5%admixture with 10% SILICA FUME as a partial replacement of cement, Compressive Strength is increased like 25.2N/mm2 and 35N/mm2 for 7 days respectively. Percentage increment is also determined i.e. 20.23% and 42.57% respectively for 7 days. Similarly, for 5% CF+ 5% Admixture and 10% CF + 5% Admixture with 10% fly ash as a partial replacement of cement, compressive strength is increased like 36.3N/mm2 and 45N/mm2 for 28 days respectively. Percentage increment is also determined i.e. 16.52% and 32.66% respectively for 28 days when compared with normal mix.

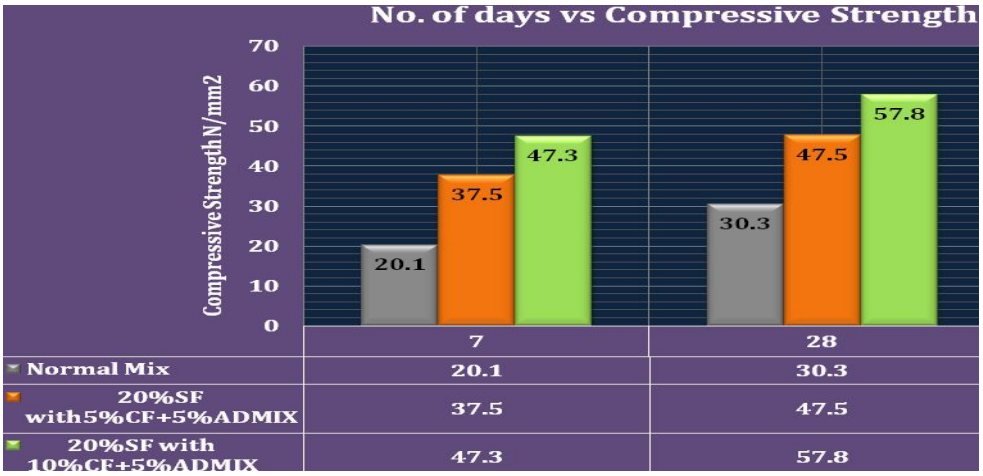

Fig. 4 Compressive Strength of Concrete Cubes with: 5% & 10 % of CF+5%Admixture with 20 % Silica Fume

As shown in this figure 4 that for 5%CF+5%Admixture with 20% SILICA FUME as a partial replacement of cement, compressive strength is increased as compared to 5%CF+5%admixture with 10% Silica fume. With 5% CF+5%Admixture with 20% Silica Fume: Compressive strength is obtained 37.5 N/mm2 and 47.5 N/mm2 for 7 & 28 days respectively. Similarly, for 10% CF+5% Admixture with 20% SILICA FUMES as a partial replacement of cement: Compressive Strength is increased like 47.3N/mm2 and 57.8N/mm2 for 28 days respectively. Percentage increment is also determined i.e. 50.24% and 55.73% for 7 days. Percentage increment is also determined i.e. 46.4% and 57.5% respectively for 7 days and Percentage increment is found out 36.21% & 47.57% for 28 days respectively when compared with normal mix.

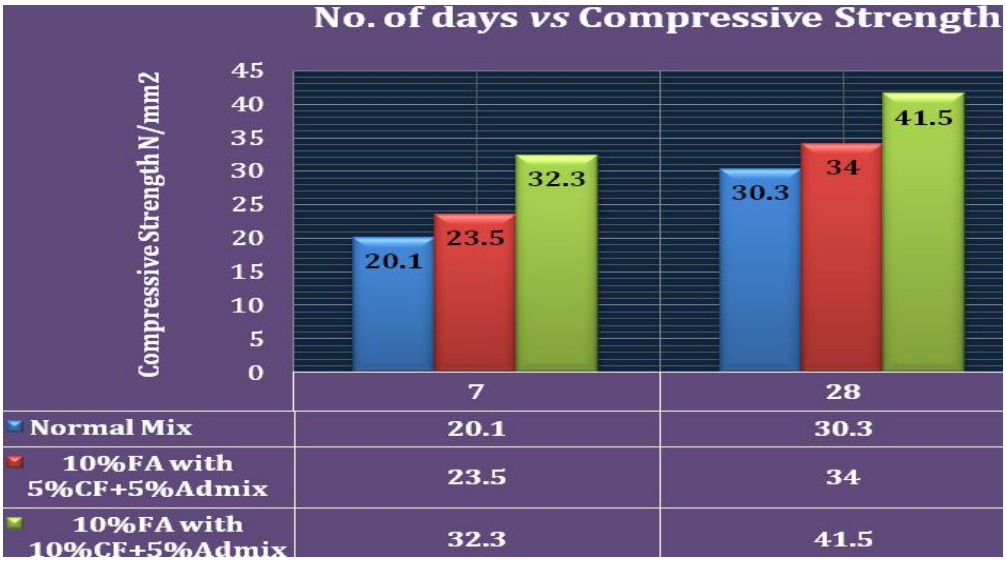

Fig 5 Compressive Strength of Concrete Cubes with: 5% & 10 % of CF+5%Admixture with 10 % Fly Ash

In above figure 5 a graph has been plotted between 5% CF + 5% Admixture & 10% CF + 5% Admixture with 10% FLY ASH as a partial replacement of cement. For normal mix concrete values are already determined like 20.1 N/mm2 and 30.3 N/mm2 for 7 and 28 days respectively. Now for 5% CF+5% Admixture and 10% CF+5% Admixture with 10% FLY ASH as a partial replacement of cement, Compressive Strength is increased like 23.5N/mm2 and 34N/mm2 for 7 & 28 days respectively. Similarly, for 5% CF+ 5% Admixture and 10% CF + 5% Admixture with 10% fly ash as a partial replacement of cement, compressive strength is increased like 32.3N/mm2 and 41.5N/mm2 for 28 days respectively. Percentage increment is also determined with respect to compressive strength and i.e.14.46% and 37.77% for 7 days respectively when compared with normal mix.

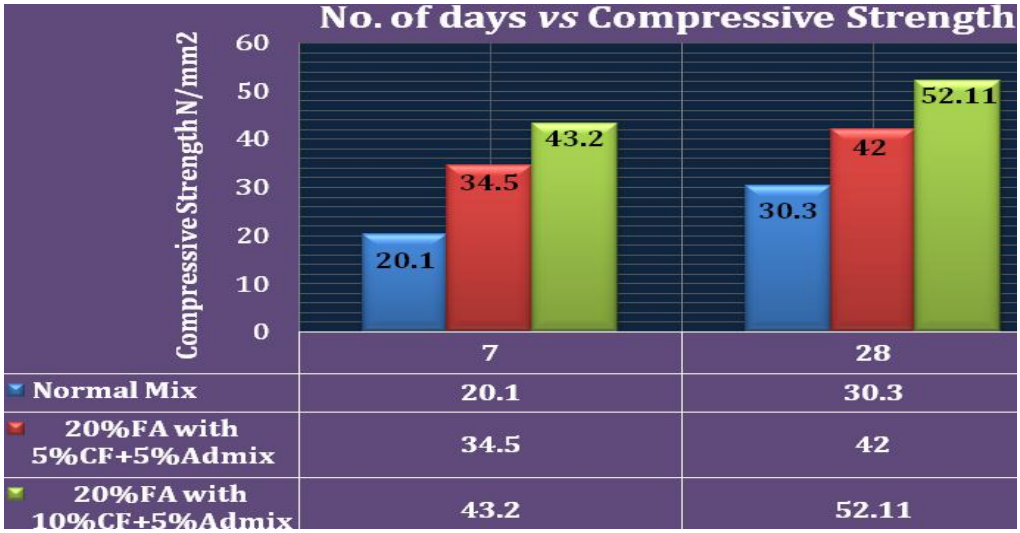

Fig 6 Compressive Strength of Concrete Cubes with: 5% & 10 % of CF+5%Admixture with 20 % Fly Ash

As shown in this figure 6 that for 5% CF+5% Admixture with 20% FLY ASH as a partial replacement of cement, compressive strength is increased as compared to 5% CF+5% Admixture with 10% Fly Ash. With 5% CF+5% Admixture with 20% Fly Ash: Compressive strength is obtained 34.5 N/mm2 and 42 N/mm2 for 7 & 28 days respectively. Similarly, for 10% CF+5% Admixture with 20% Fly Ash as a partial replacement of cement: Compressive Strength is increased like 43.2N/mm2 and 52.11N/mm2 for 28 days respectively. Percentage increment is also determined with respect to compressive strength and i.e. 41.73% and 53.47% for 7 days respectively. Percentage increment is also determined with respect to compressive strength and i.e. 27.85% and 41.85% respectively for 28 days respectively when compared with normal mix.

V. CONCLUSIONS

1) By increasing the amount of silica fume (SF) from 10% to 20% with inclusion of 5% and 10% Coir Fiber (CF) plus 5% Admixture slump value is decreasing continuously. For 5% Coir Fiber+5% ADMIX with 10% SF slump value is 120mm & for 10% Coir Fiber + 5% ADMIX with 10% SF it is 115mm. Similarly, for 10% Coir Fiber + 5% ADMIX with 20% SF it is 110mm & for 10% Coir Fiber +5% ADMIX with 20% SF it is 105mm.By increasing the amount of fly ash as 10% and 20% with 5% & 10% coir fiber plus 5% admixture workability has been increased and compaction factor will also be increased. By adding silica fume as a partial replacement of cement in concrete mix with 5% and 10% coir fiber and 5% admixture workability will be increased much more as compare to by adding fly ash as a partial replacement of cement with 5% and 10% coir fiber including 5% admixture in M-30 concrete mix design.

2) For normal mix concrete values are already determined like 20.1 N/mm2 and 30.3 N/mm2 for 7 and 28 days respectively. Now for 5% CF+5%Admixture and 10%CF+5%admixture with 10% SILICA FUME as a partial replacement of cement, Compressive Strength is increased like 25.2N/mm2 and 35N/mm2 for 7 days respectively. Similarly, for 5% CF+ 5% Admixture and 10% CF + 5% Admixture with 10% fly ash as a partial replacement of cement, compressive strength is increased like 36.3N/mm^2 and 45N/mm^2 for 28 days respectively.

3) For 10% CF+5% Admixture with 20% SILICA FUMES as a partial replacement of cement: Compressive Strength is increased like 47.3N/mm^2 and 57.8N/mm^2 for 28 days respectively. Percentage increment is also determined i.e. 50.24% and 55.73% for

7 days. Percentage increment is also determined i.e. 46.4% and 57.5% respectively for 7 days and Percentage increment is found out 36.21% & 47.57% for 28 days respectively when compared with normal mix .

4) For 5% CF+ 5% Admixture and 10% CF + 5% Admixture with 10% fly ash as a partial replacement of cement, compressive strength is increased like 32.3N/mm^2 and 41.5N/mm^2 for 28 days respectively. Percentage increment is also determined with respect to compressive strength and i.e.14.46% and 37.77% for 7 days respectively when compared with normal mix. Similarly, for 10% CF+5% Admixture with 20% fly Ash as a partial replacement of cement: Compressive Strength is increased like 43.2N/mm^2 and 52.11N/mm^2 for 28 days respectively.

5) For 10% SF with 10% coir fiber including 5% admixture compressive strength increment is 35 N/mm2 and 45 N/mm2 for 7 & 28 days respectively as compare to 5% coir fiber including 5% admixture. But for 20% SF strength is more increased with 10% coir fiber including 5%admixture and i.e. 47.3 N/mm2 and 57.8 N/mm2 for 7 and 28 days respectively as compare to 5% coir fiber including 5%admixture. By increasing the amount of fly ash from 10 to 20% compressive strength have been increased.

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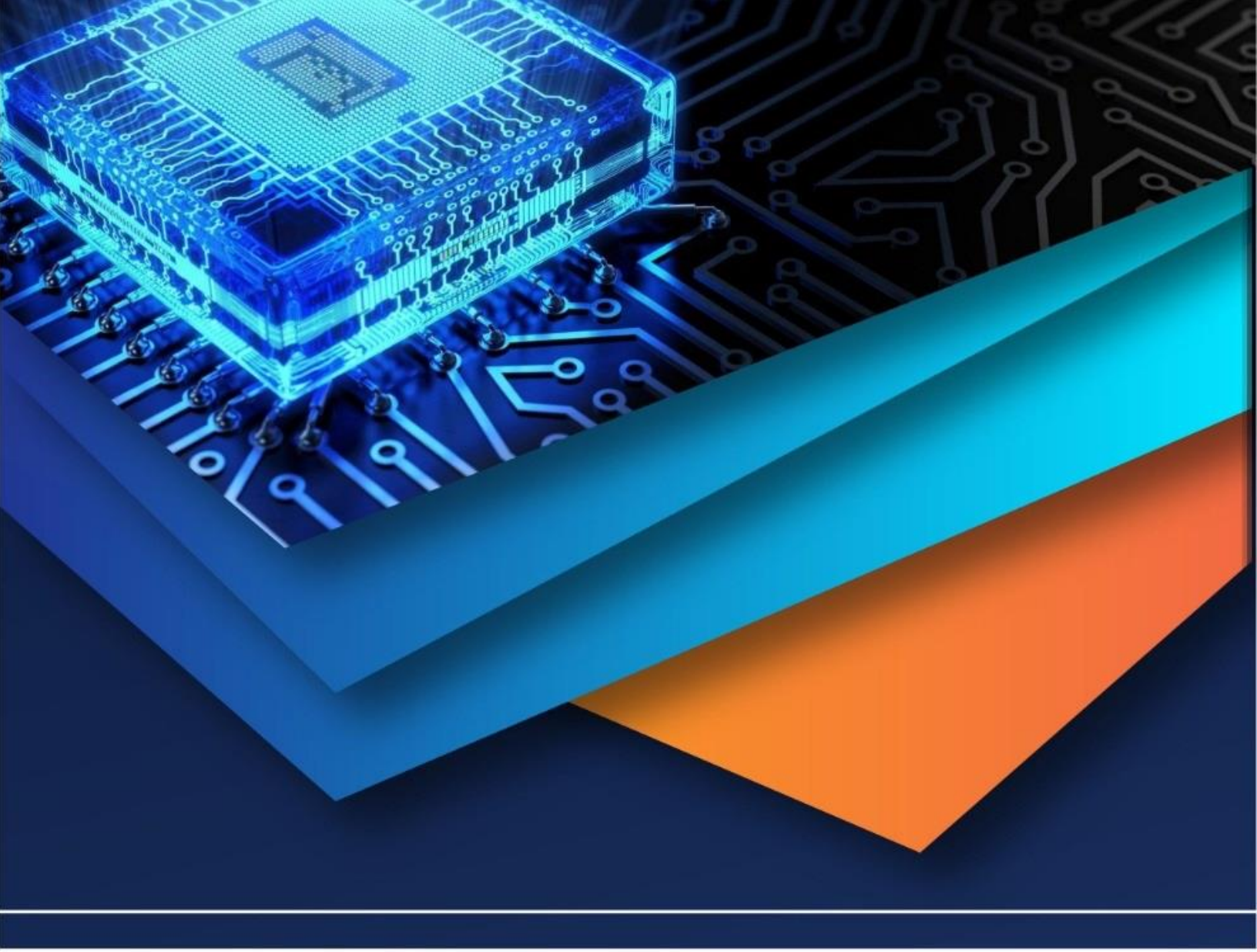

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