Effect of Quarry Dust on Class C Fly Ash Concrete

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***Abstract* - The requirement of natural sand and cement is increasing day by day. The demand of these two constituents is reaching high. So there is a need to be found the suitable alternative materials to fill those requirements. In this investigation presents the experimental work of partial replacement of cement by class C fly ash along with quarry dust for sand. The cement is replaced by fly ash at 10%, 20%, 30%, 40% with quarry dust by 0%, 25%, 50% of concrete specimens were prepared. The specimens are curing at the ages of 7, 28, 60 days and tested for compressive and split tensile strength.**

***Index terms* - concrete, quarry dust, class C fly ash, compressive strength.**

I. INTRODUCTION

The fly ash is the mostly used cementitious material in concrete. The fly ash production in India is approximately 80 million tons per year but the amount of utilizationof fly ash is 10 % only. The construction companies starting to using the fly ash for manufacturing of cement but still the amount of fly ash usage is low. Class C Fly ash is generally used for the replacement of cement. Were the lime content is more than 20% is called the class C fly ash. The class C fly ash is made the concrete to have higher workability, long term strength and to make the concrete more economically.

The increasing rate of demand of natural sand is increased more and the cost of the sand also increased. Quarry dust is the replacing material for fine aggregate. Quarry dust is a by-product of crushing stones. It will increasing the strength of concrete over concrete made with natural sand but it causes a reduction in the workability of concrete. To reduce the impact of these materials on environment by using these wastes as admixtures in concrete. This investigation carried out the strength characteristics of concrete by the different percentages and also the quality of concrete.

II. LITERATURE REVIEW

Though number of significant results have been reported on the use of Class F fly ash in concrete [1–14], but there is not much literature available on the use of Class F fly ash as partial replacement of fine aggregates [10–14]. Maslehuddinet al. [10] carried out investigations to evaluate the compressive strength development and corrosion-resisting characteristics of concrete mixes in which fly ash was used as an admixture (equal quantity of sand replacement). Concrete mixtures were made with fly ash additions of 0%, 20%, and 30%, and water–cement ratios of 0.35, 0.40, 0.45, and 0.50.Based on the test results, they concluded that addition of flyash as an admixture increases the early age compressive strength and long-term corrosion-resisting characteristics of concrete. The superior performance of these mixes compared to plain concrete mixes was attributed to the densification of the paste structure due to pozzolanic action between the fly ash and the calcium hydroxide liberated as a result of hydration of cement.

III. MATERIALS

a) Ordinary Portland cement

The cement used for this investigation work is ordinary Portland cement (OPC) 53 grade conforming to IS: 12267 – 1987. The properties as shown in table 1

Table 1 Physical properties of ordinary Portland cement

S.No	Properties	Values
1.	Specific gravity	3.14
2.	Standard consistency	26%
3.	Initial setting time	40 min
4.	Final setting time	246 min
5.	Fineness	3%

b) Fly ash

In this investigation class C fly ash having specific gravity of 2.35 obtained from Thermal power station which is located at Mettur in Tamil Nadu is used for the replacement of cement.

c) Fine aggregate

Locally available river sand passing through 4.75 mm and retained on 150 micron IS sieves is taken as fine aggregate conforming to zone-III as per IS 383 – 1970. The properties of fine aggregate as shown in table 2

Table 2 Physical properties of sand and quarry dust

S.No	Properties	Test values of Sand	Test values of quarry dust
1.	Specific gravity	2.72	2.68
2.	Bulking of sand	22%	23.5%
3.	Fineness modulus	2.57	2.55
4.	Water absorption	0.75%	1.20%
5.	Particle size range	0.15 to 4.75 mm	0.15 to 4.75 mm

d) Quarry dust

The quarry dust used for this investigation work is obtained from the quarry near Melmaruvathur in Tamil Nadu. The quarry dust passing through 4.75 mm retained on 150 micron IS sieves are taken. The properties of quarry dust are shown in table 2.

e) Coarse aggregate

Locally available coarse aggregates are taken. The aggregate is passing through is sieve 20 mm. the properties of coarse aggregates are shown in table 3.

Table 3 Physical properties of coarse aggregate

S.No	Properties	Test values
1.	Specific gravity	2.88
2.	Fineness modulus	3.44
3.	Water absorption	0.97%
4.	Bulk density	1477 kg/m^3
5.	Size	20 mm

f) Water

Water is the important ingredients of concrete. Ordinary portable water is used throughout the investigation as well as for the curing of concrete specimens.

IV. MIX DESIGN

In this investigation concrete mix design M30 was designed based on IS 10262. This method is limited to high strength concrete production using conventional materials and production techniques. The mix proportioning for mixes are given below.

Table 4 Mix proportion

Cement	Fine aggregate	Coarse aggregate	W/C
1	1.50	3.10	0.42

Table 5 Mix designation for concrete mixtures

S.No	Mix designation	Cement	Fly ash	Fine aggregate	Quarry dust	Coarse aggregate
1.	M0	100%	0%	100%	0%	100%
2.	M1	90%	10%	100%	0%	100%
3.	M2	90%	10%	75%	25%	100%
4.	M3	90%	10%	50%	50%	100%
5.	M4	80%	20%	100%	0%	100%
6.	M5	80%	20%	75%	25%	100%
7.	M6	80%	20%	50%	50%	100%
8.	M7	70%	30%	100%	0%	100%
9.	M8	70%	30%	75%	25%	100%
10.	M9	70%	30%	50%	50%	100%
11.	M10	60%	40%	100%	0%	100%
12.	M11	60%	40%	75%	25%	100%
13.	M12	60%	40%	50%	50%	100%

V. EXPERIMENTAL PROCEDURE

The physical properties of all constituent materials should be tested before starting the work. It is very important to find out the specific gravity of materials. The test should be made by the relevant code practices. The fresh concrete was subjected to the slump and compaction factor tests followed by casting of concrete in moulds for the further investigation. All mixes were prepared by mixing the concrete in laboratory mixer along with water. For compressive strength 96 NOS cube specimens of size 150 mm x 150 mm x 150 mm, for flexural strength studies, 96 NOS prisms specimens of size 100 mm x 100 mm x 500 mm, and 96 NOS cylinder specimen of size 300 mm height and 150 mm diameter for strength studies were prepared.Moulds are removed after 24 hours of casting and cured in water up to the date of testing. The cubes and cylinders are analysed after their curing periods.

VI. RESULT AND ANALYSIS

a. Compressive strength

Compressive strength test is the most common test to be conducted on hardened concrete as it is easy to perform. The tests are to be made on the compressive strength testing machine for both cube and cylindrical samples. The compressive strength of concrete cubes are tested at 7,28,60,120 days of curing periods. As well as the same for cylindrical samples. The mean compressive strength is calculated as shown in table.

Fig.1 compressive strength testing

Table 6 Compressive strength values for concrete cubes

S.No	Class C fly ash %	Compressive strength N/mm^2		
		Quarry dust %		
		0	**25**	**50**
7 days				
1.	10	24.38	25.33	26.18
2.	20	23.32	24.33	25.47
3.	30	25.42	26.56	27.89
4.	40	26.45	27.43	28.56
28 days				
5.	10	25.66	26.65	27.31
6.	20	25.12	25.63	26.32
7.	30	26.12	26.92	27.35
8.	40	27.65	28.12	28.35
60 days				
9.	10	26.42	27.71	28.27
10.	20	25.46	26.72	27.85
11.	30	27.54	28.43	29.57
12.	40	28.72	29.82	30.83

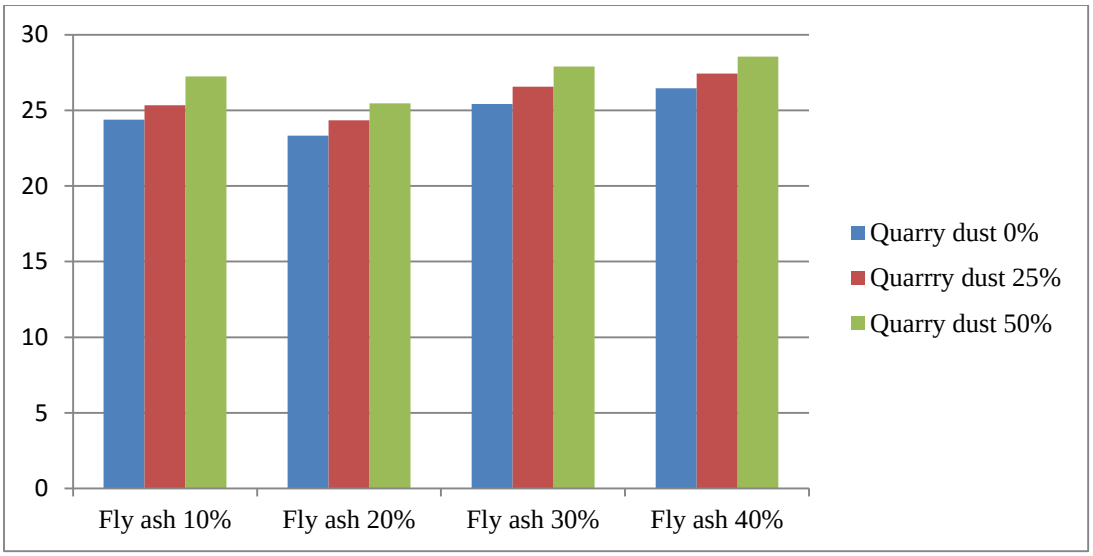

Fig.2 variation of compressive strength for concrete cubes at 7 days

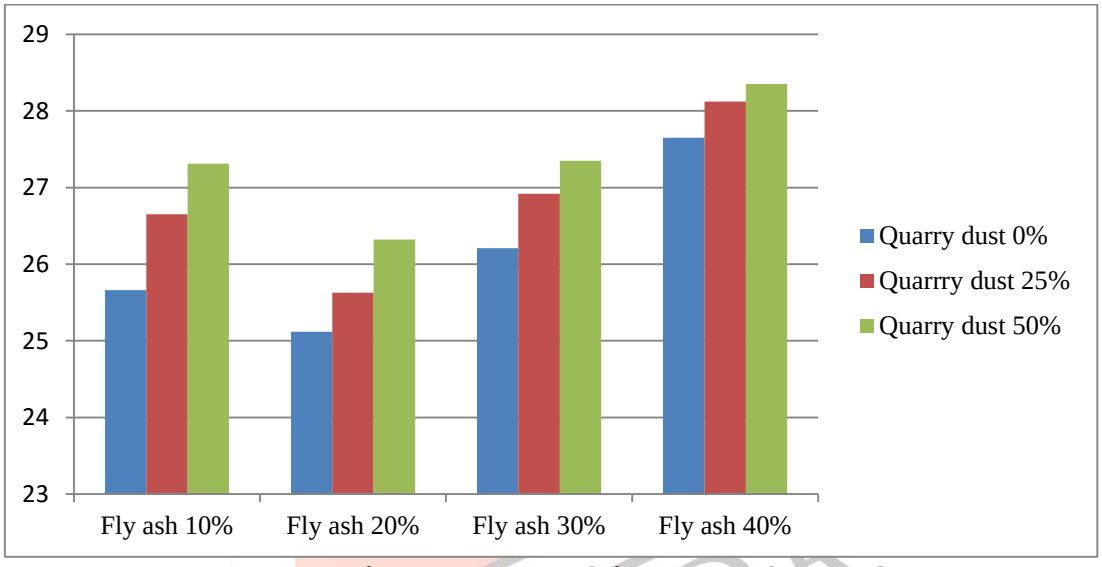

Fig.3 variation of compressive strength for concrete cubes at 28 days

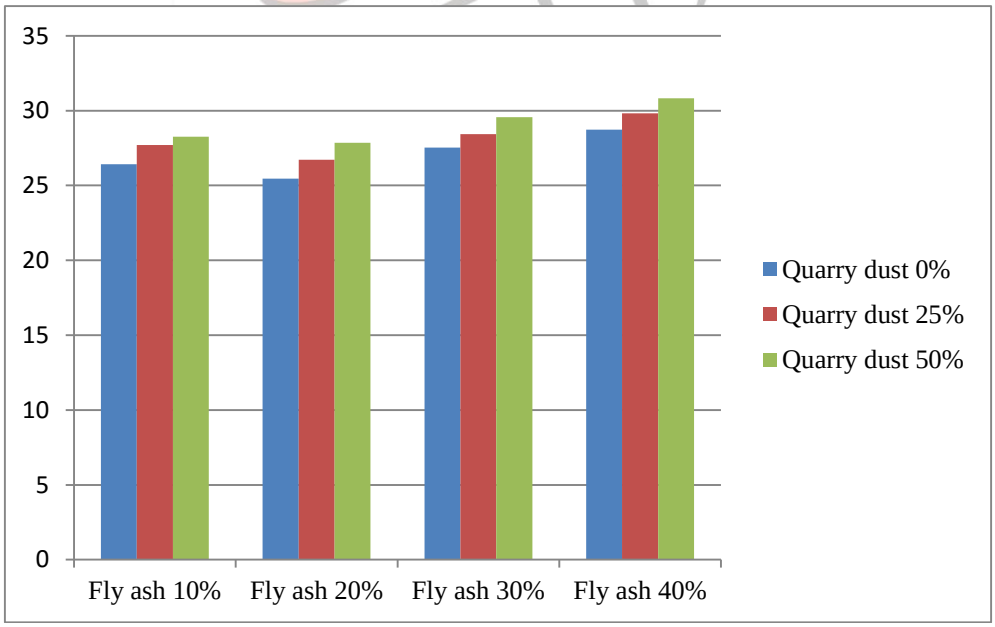

Fig.4 variation of compressive strength for concrete cubes at 60days

From the figure 1,2 and 3 it is observed that the maximum strength occurs at 40% in fly ash and 50% in quarry dust. When compared to controlled concrete the amount of strength decreased in 20% at fly ash and after that the strength increased at 30% and 40% for fly ash of the curing period.

b. Tensile strength test

The split tensile strength test is to determining the tensile strength of the results of the high performance concrete mixes at the ages of 7, 28, 60 days as shown in table.

Fig4. Split tensile strength testing

Table 7 Tensile strength values for concrete cylinders

S.No	Class C fly ash %	Split tensile strength N/mm^2		
		Quarry dust %		
		0	**25**	**50**
7 days				
1.	10	2.62	2.73	2.81
2.	20	2.82	2.85	2.97
3.	30	2.72	2.79	2.92
4.	40	2.87	2.92	3.11
28 days				
5.	10	2.69	2.82	2.93
6.	20	2.75	2.89	3.01
7.	30	2.71	2.83	2.97
8.	40	2.84	2.91	3.08
60 days				
9.	10	2.76	2.87	2.93
10.	20	2.85	2.95	3.01
11.	30	2.8	2.91	2.97
12.	40	2.92	2.98	3.08

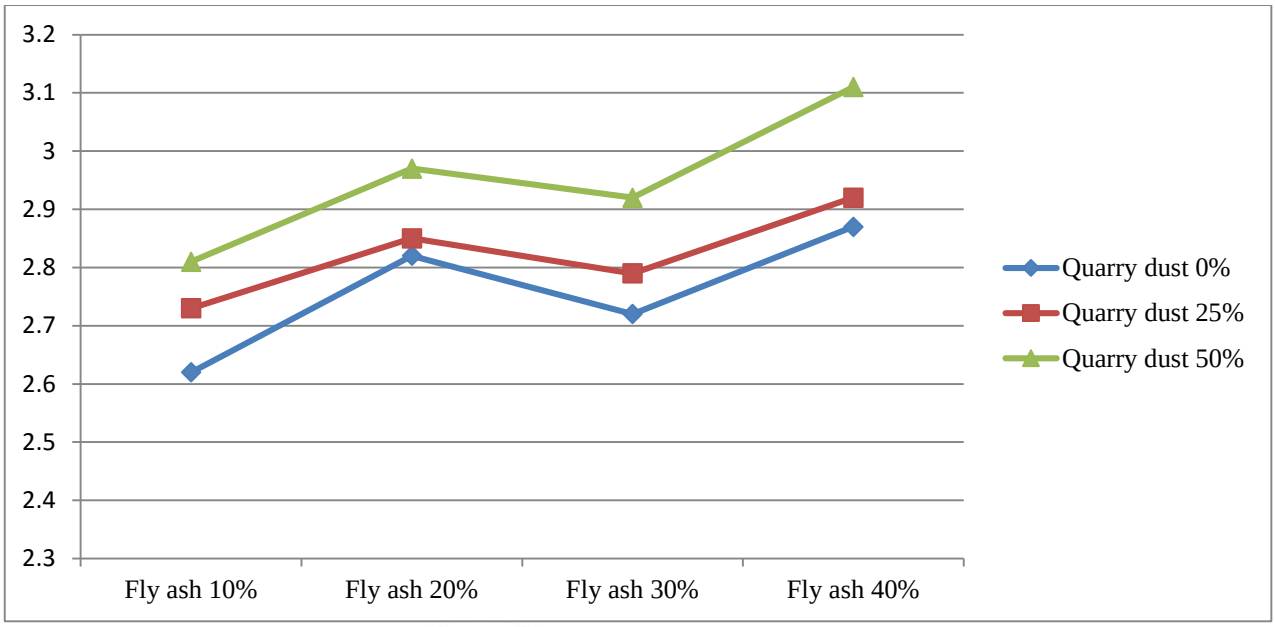

Fig.5 variation of split tensile strength for concrete cylinders at 7 days

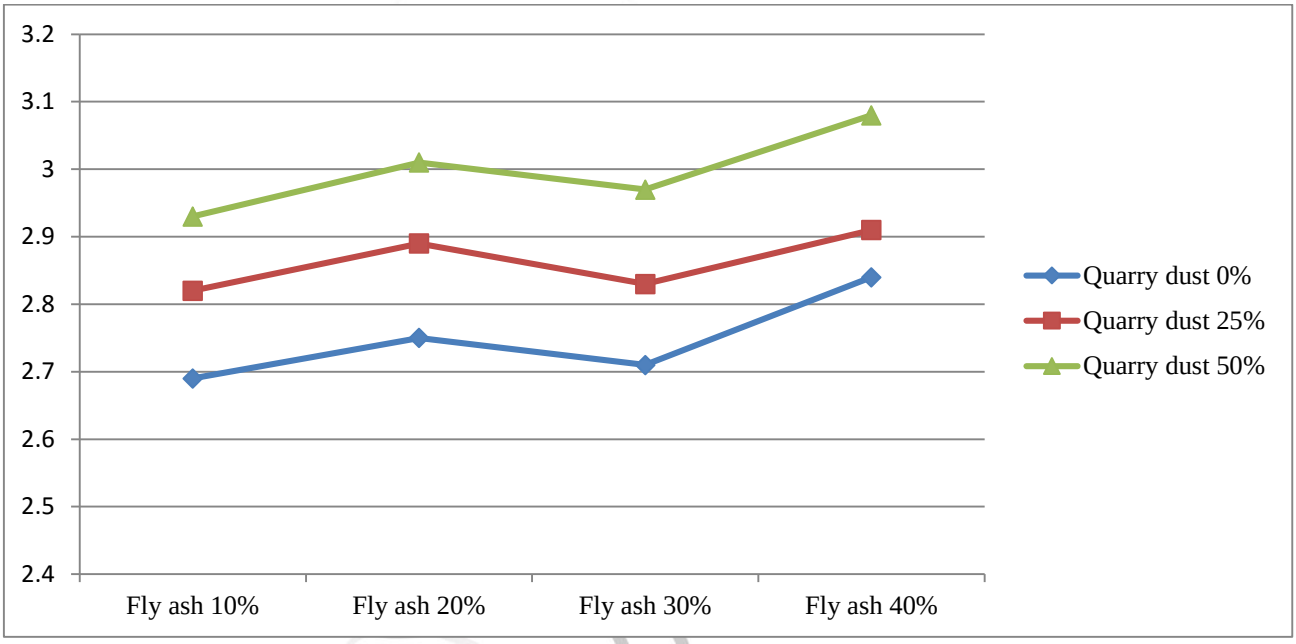

Fig.6 variation of split tensile strength for concrete cylinders at 28 days

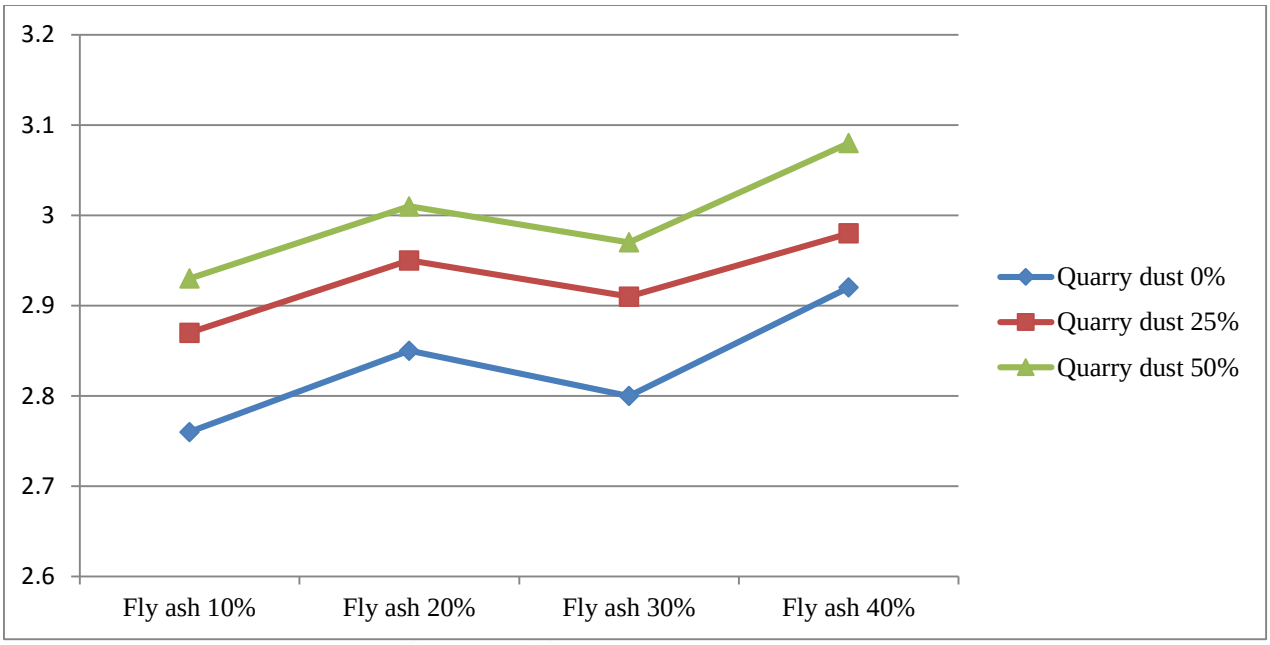

Fig.7 variation of split tensile strength for concrete cylinders at 60 days

From the figure 4, 5 and 6 it is observed that the maximum strength occurs at 40% in fly ash and 50% in quarry dust. When compared to controlled concrete the amount of strength decreased in 20% at fly ash and after that the strength increased at 30% and 40% for fly ash of the curing period.

VII. CONCLUSION

In the literature survey reported that the fly ash in concrete reduces the compressive strength in early stages and improved in the later stages. The early strength is decreased further increasing the percentage of fly ash. But when increasing the percentage of quarry dust with the fly ash is increasing the strength in the later ages. The 25%, 50% of quarry dust with 20% of fly ash is decreasing the strength and increasing at 30%, 40% of fly ash.So that the 50% replacement of sand along with 40% of fly ah can be achieved.

VIII. REFERENCES

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