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STRENGTH AND COST COMPARISON OF NORMAL AND HIGH VOLUME FLYASH CONCRETE

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ABSTRACT

Concrete, typically composed of gravel, sand, water, and portland cement, is an extremely versatile building material that is used extensively worldwide. Reinforced concrete is very strong and can be cast in nearly any desired shape. Unfortunately, significant environmental problems result from the manufacture of Portland cement. Worldwide, the manufacture of Portland cement accounts for 6-7% of the total carbon dioxide (CO2) produced by humans, adding the greenhouse gas equivalent of 330 million cars driving 12,500 miles per year. Fortunately, a waste product Fly Ash can be substituted for large portions of Portland cement, significantly improving concrete's environmental characteristics. Fly Ash, consisting mostly of silica, alumina, and iron, forms a compound similar to Portland cement when mixed with lime and water. Fly ash is a non- combusted by-product of coal-fired power plants and generally ends up in a landfill. However, when high volumes are used in concrete (displacing more than 25% of the cement), it creates a stronger, more durable product and reduces concrete's environmental impact considerably. Due to its strength and lower water content, cracking is reduced.

I. INTRODUCTION

Consequent upon increased generation of electricity through thermal route involving combustion of pulverized coal/ignite, concurrent generation of fly ash in bulk quantities is a matter of serious concern not only because of issues associated with its disposal and utilization but also because of its threat to public health and ecology. At present, large quantity of fly ash is being dumped in slurry form in large areas close to the power plants without being put to gainful use in India. Only a very small percentage (<35%) of fly ash generated in India is being used for gainful applications whereas the corresponding figures of other countries may vary from 60 to 100%.

Although fly ash offers environmental advantages, it also improves the performance and quality of concrete. Fly ash affects the plastic properties of concrete by improving workability, reducing water demand, reducing segregation and bleeding, and lowering heat of hydration. Fly ash increases strength, reduces permeability, reduces corrosion of reinforcing steel, increases sulphate resistance, and reduces alkali-aggregate reaction. Fly ash reaches its maximum strength more slowly than concrete made with only portland cement. The techniques for working with this type of concrete are standard for the industry and will not impact the budget of a job. So as a Civil Engineer we should effectively try to use fly ash in construction, as it helps in saving environment with reduced construction cost along with many other advantages, but now question rises to what extent or percentage fly ash could be used in concrete for construction works, and to answer this present study have been made.

II. OBJECTIVES

The main objective of the present study is to compare the strength characteristics of M40 concrete by using sample of different percentages of fly ash by mass of cementitious material, and also comparison is made between there cost. To achieve this objective following steps are to be followed:

1) Design of M40 concrete mix to obtain the ratio of different components of concrete.

2) By using the above calculated ratio samples for compressive and flexural strength test for 28%, 50%, 70% replacement of cement by fly ash is to be made.

3) Compressive strength of 3,7 and 28 days is to be calculated by casting cubes for M40 mix at 28%, 50% and 70% fly ash replacement by cement.

4) Flexural strength of 28 and 56 days is to be calculated by casting beam shaped samples of M40 mix at 28%, 50% and 70% fly ash replacement by cement.

5) Comparison of the compressive and the flexural strength obtained at different percentages of fly ash is to be made.

6) Cost comparison of 28%, 50% and 70% fly ash concrete is to be made.

III. SCOPE OF STUDY

The scope of present study aims at providing the M40 concrete with that optimum quantity of fly ash content which could be used in structure or road construction with acceptable strength values so, that the cost of construction can be reduced to a great extent and also by achieving this the harmful impact of fly ash on environment could be reduced.

IV. EXPERIMENTAL PROGRAMME

The following test programme was planned to investigate the results:

1. To obtain the physical properties of the concrete constituents i.e. Pozzolanic Portland cement (PC), fine aggregates, coarse aggregate and fly ash.
2. Development of various mix combinations for concrete.
3. Casting and curing.
4. Testing of specimens for Compressive Strength and flexural strength.

V. RESULTS AND DISCUSSIONS

Table 5.1 (a): Compressive strength of M40 concrete for 28% fly ashcontent.

Sr.No	% Fly Ash Concrete	Curing Period	Compressive Strength	Average Compressive
1.	28%	3	25 22	24.33
2.	28%	7	34 28	32.33
3.	28%	28	46 45	46.60

Table 5.1 (b): Compressive strength of M40 concrete for 50% fly ashcontent.

Sr.No	% Fly Ash Concrete	Curing Period (days)	Compressive Strength (N/mm^2)	Average Compressive Strength(N/mm^2)
1.	50%	3	19.5 20.20 20.50	20.03
2.	50%	7	27.40 25.80 25.10	26.10
3.	50%	28	42.00 41.00 40.00	41.00

Table 5.1 (c): Compressive strength of M40 concrete for 70% fly ashcontent.

Sr.No	% Fly Ash Concrete	Curing Period (days)	Compressive Strength (N/mm^2)	Average Compressive Strength(N/mm^2)
1.	70%	3	8.57 11.02 11.47	10.34
2.	70%	7	15.3 15.00 14.40	15.00
3.	70%	28	29.00 27.00 25.00	27

Table 5.2: Combined Table of Compressive strength of M40 concrete for 28%, 50% and 70% fly ashcontent.

Percent Fly Ash Concrete	3 Days Curing (Mean Mpa)	7 Days Curing (Mean Mpa)	28 Days Curing (Mean Mpa)
28%	24.33	32.33	46.6
50%	20	26.1	41
70%	10.3	15	27

Table 5.3 (a): Flexural strength of M40 concrete for 28% fly ashcontent.

Sr.No	% Fly Ash Concrete	Curing Period (days)	Flexural Strength (N/mm^2)	Average Flexural Strength(N/m^2)
1.	28%	28	6.50 5.00 5.50	6.00
2.	28%	56	8.00 7.00 8.52	7.84

Table 5.3 (b): Flexural strength of M40 concrete for 50% fly ashcontent.

Sr.No	% Fly Ash Concrete	Curing Period (days)	Flexural Strength (N/mm^2)	Average Flexural Strength(N/mm^2)
1.	50%	28	5.00 4.00 5.7	4.90
2.	50%	56	7.00 8.00 6.00	7.00

Table 5.3 (c): Flexural strength of M40 concrete for 70% fly ashcontent.

Sr.No	% Fly Ash Concrete	Curing Period (days)	Flexural Strength (N/mm^2)	Average Flexural Strength(N/mm^2)
1.	70%	28	1.50 2.50 2.00	2
2.	70%	56	4.00 3.00 4.7	3.9

Table 5.4: Combined Table of Flexural strength of M40 concrete for 28%, 50% and 70% fly ashcontent.

Percent Fly Ash Concrete	28 Days Curing (Mean Mpa)	56 Days Curing (Mean Mpa)
28%	6	7.84
50%	4.9	7
70%	2	3.9

VI. COST COMPARISION

Table 6.1: Market Rates of Various Components of Concrete.

Components of Concrete	Rates
Cement	6 Rs/Kg
Fine Aggregate	0.6 Rs/Kg
CA-I	0.8 Rs/Kg
CA-II	0.8 Rs/Kg
Fly Ash	100 Rs/Lt

Table 6.2 (a): Per Cubic Meter Cost of 28% Fly Ash Content M40 Concrete.

Components of Concrete	Quantity in Per Cubic Meter of Concrete	Rates	Cost
Cement	445	6 Rs/Kg	2670
Fine Aggregate	520	0.6 Rs/Kg	312
CA-I	361	0.8 Rs/Kg	289
CA-II	896	0.8 Rs/Kg	717
Admixture	4.45	100 Rs/Lt	445
Total			**4433**

Table 6.2 (b): Per Cubic Meter Cost of 50% Fly Ash Content M40 Concrete.

Components of Concrete	Quantity in Per Cubic Meter of Concrete	Rates	Cost
Cement	308	6 Rs/Kg	1848
Fine Aggregate	520	0.6 Rs/Kg	312
CA-I	361	0.8 Rs/Kg	289
CA-II	896	0.8 Rs/Kg	717
Admixture	4.45	100 Rs/Lt	445
Fly Ash	136	2 Rs/Kg	272
Total			**3883**

Table 6.2 (c): Per Cubic Meter Cost of 70% Fly Ash Content M40 Concrete.

Components of Concrete	Quantity in Per Cubic Meter of Concrete	Rates	Cost
Cement	185	6 Rs/Kg	1110
Fine Aggregate	520	0.6 Rs/Kg	312
CA-I	361	0.8 Rs/Kg	289
CA-II	896	0.8 Rs/Kg	717
Admixture	4.45	100 Rs/Lt	445
Fly Ash	260	2 Rs/Kg	520
Total			**3393**

Table 6.2 (d): Per Cubic Meter Cost of 28% Fly Ash Content M25 Concrete.

Components of Concrete	Quantity in Per Cubic Meter of Concrete	Rates	Cost
Cement	398	6 Rs/Kg	2388
Fine Aggregate	599	0.6 Rs/Kg	360
CA-I	338	0.8 Rs/Kg	270
CA-II	878	0.8 Rs/Kg	702
Admixture	3.98	100 Rs/Lt	398
Total			**4118**

VII. CONCLUDING REMARKS

Base on the present study following conclusions can be drawn:

1) The compressive and flexural strength of M40 concrete at 50% fly ash replacement by the mass of cement are acceptable, and therefore can be used in construction practice.

2) If we compare M25 concrete with the compressive and flexural strength of M40 concrete at 70% fly ash replacement by the mass of cement the result are acceptable and at a cost lower than M25 concrete.

3) The present study works on following three R's:

a) Reuse

b) Reduce

c) Recycle

As in this present study I have Reused the waste product i.e. fly ash, by Reducing the quantity of cement in concrete, in this way the waste product i.e fly ash, is Recycled into a much useful and cost effective concrete.

4)If more serious work is done in this field surely concrete and construction industry would be in gainful side and concrete upto some extent would be eco-friendly.

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