Volume : 1 | Issue : 12 | September 2012 ISSN - 2249-555X

Research Paper Engineering

Design and Evaluation of High Volume Fly ash Concrete for Rigid Pavements-White Topping

*Nikhil T. R.

* Assistant Professor, Department of Civil Engineering, Acharya Institute of Technology, Bangalore 90, India

ABSTRACT

Cement is the second largest material consumed after water. Now a day's concrete pavements are gaining popularity for its own good paving properties. As such a consumption of cement is increased drastically. As cement demand increases, production also increases. Every tone of production of cement releases approximately one tones of total carbon dioxide. In many industries, including power plants, coal is used as fuel. This generates tones of coal ash, which is very difficult to dispose off, which in turn causes pollution. Thus the production of cement and electricity contributes huge amount of carbon dioxide emissions and coal ash causing environmental pollution. Fly ash contains reactive constituents and unreactive crystalline matter. Reactive constituents reacts with lime and offers hydrated minerals to impart strength and un reactive matter gives packing effect to the concrete, filling up of pores and thus increases the strength Here an attempt is being made to consume this pollution causing material to a utility by using it in concrete. Whenever concrete is used as overlay it should posses certain properties to suit for overlay, like strength, flexure, modulus of elasticity etc. because of all these reason here an attempt is being made to design a concrete mixture for M-60 grade, by using high volume fly ash into it. After the mix design, the concrete is being evaluated for overlay properties such as compressive strength, flexural strength etc. In the design of high volume fly ash concrete use of chemical admixtures is inevitable, and it is proposed to use the super plasticizer. Since the compatibility of super plasticizer is different with different cement .As such it is required to tests the compatibility of super plasticizer with cement. By the tests we can conclude that 55% replacement of cement by fly ash is the optimal percent above which strength decreases.

Keywords : Cement, Fly ash, sustainability, Compressive, Flexural

Introduction

Fly ash is a finely divided residue obtained from the combustion of powdered coal and transported by the flue gasses and collected by electrostatic precipitator.

The important property of fly ash is its spherical form; because of its spherical shape it improves the workability of concrete, when it is substituted for cement at certain percentages. Fly ash contains reactive constituents and unreactive crystalline matter.

Reactive constituents reacts with lime and offers hydrated minerals to impart strength and reactive matter gives packing effect to the concrete, filling up of pores and thus by increases the strength Here an attempt is being made to consume this pollution causing material to a utility by using it in concrete.

Whenever concrete is used as overlay it should posses certain properties to suit as overlay, like strength, flexural strength, modulus of elasticity etc. because of all these reason here an attempt is being made to design a concrete mixture for M-60 grade, by using high volume fly ash into it. After design the concrete, the concrete is being evaluated for overlay properties such as compressive strength, flexural strength, modulus of elasticity etc in the design of high volume fly ash concrete use of chemical admixtures is inevitable .Chemical admixtures are in liquid form and are mainly used in concrete to modify the workability properties.

It is used to produce desired effects more economically and is BEST if added to the mixing water.

Fly ash utilization scenario in India

Collection of Fly ash at Raichur Thermal Power plant

Disposal of fly ash is a major environmental issue. If buried in ground, every ton of fly ash requires 1 sq.km. of land. Between now and 2015, fly ash availability in India is expected to more than double to about 200 million tons. Land filling for this quantity would render a large area of land permanently and useable. That is why it is a good idea to use fly ash in cement for concrete making. It is not an idea simply to dispose of fly ash. Researches has proved a mass of evidence to prove that mixture of fly ash in cement in given proportion results in better governing qualities, strengths, finish etc. it also makes a lot of economic sense to both the clients and construction contractors. A major use of fly ash is to replace Portland cement in concrete. India is way behind the other countries in this regard. For instance, Japan utilizes around 94% of its 6.2 million tons of fly ash for concrete compared to only 4% in India. Ministry of Environment and forests have issued a notification making it compulsory to use at least 25% fly ash for manufacturing clay bricks or tiles of blocks within a radius of 100kms from a coal or lignite based thermal plant. It is also being made mandatory for every construction agency engaged in construction of building within a range of 50kms

to 100kms from a coal or thermal plant.

Present Investigation

The experimental work was carried out in three stages. In the first stage compatibility test is made to select the type of cement. Second stage preliminary investigations such as consistency, specific gravity, initial and final setting time of cement and sieve analysis of fine aggregates and coarse aggregates were carried out on materials used. In the third stage concrete mix proportioning was done as per the draft code (IS: 10262) and cubes, beams and cylinders were casted and tested. The cubes beams and cylinders were tested properly in uniaxial compressive testing machine, flexural testing machine and split tensile testing machine at the age of 7, 14,28 and 56 days.

Table No 1: Mix proportioning of Concrete as per IS: 10262-1982.

Fly ash (%)	0	40	45	50	55	60	65
Cement (kg/m^3)	479	287.4	311.35	239.5	215.55	191.6	167.65
Fly ash(kg/m^3)	0	191.6	215.55	239.5	263.45	287.4	311.35
Water(kg/m^3)	191.58	191.58	191.58	191.58	191.58	191.58	191.58
Water/ Binder ratio	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Fine aggregate (kg/m^3)	524.28	524.28	524.28	524.28	524.28	524.28	524.28
Coarse aggregate (kg/m^3)	1120.95	1120.95	1120.95	1120.95	1120.95	1120.95	1120.95
Super plasticizer (%)	1.6	1.6	1.6	1.6	1.6	1.6	1.6
Workability CF	0.80	0.82	0.83	0.84	0.85	0.86	0.86

Results

The results of compression test and flexural test are given below

Table No 2: Compressive Strength test results

Fly Ash (%)	0	40	45	50	55	60	65
Curing Days	28	56	56	56	56	56	56
Average Compressive strength (N/mm2)	67.5	61.48	61.92	63.95	66.19	46.33	45.16

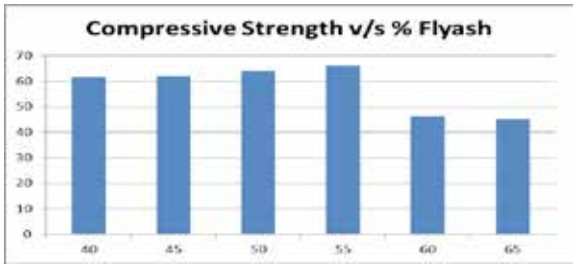
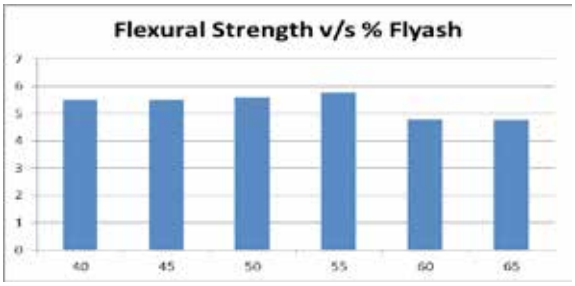


Table No 3: Flexural Strength test results

Fly Ash (%)	0	40	45	50	55	60	65
Curing Days	28	56	56	56	56	56	56
Average Flexural strength (N/mm2)	5.75	5.50	5.51	5.59	5.75	4.8	4.78



Discussions and Conclusion

Based on the experimental results the following Conclusions were made.

1. The mean target strength is achieved at cement quantity of 470 kg/m3 with W/C ratio 0.4 at super plasticizer 1.6%.
2. It has been observed that concrete with 55% replacement of Fly ash at 56 days curing with 1.6% super plasticizer, the maximum compressive strength of 67.58 Mpa is obtained. The workability measured at this stage 0.85.
3. It has been observed that concrete with 55% replacement of Fly ash at 56 days curing with 1.6% super plasticizer, the maximum flexural strength of 5.75 Mpa is obtained.
4. It has been observed that, with increase in percentage of addition of Fly ash the workability also increases.
5. The rate strength developed in Fly ash concrete is slow at early ages. It may be due to delayed Pozzolanic activity, however at later stages the strength development increases. From this it can be concluded that Fly ash concrete should be cured for longer duration.
6. Fly ash concrete develops strength at lower rate and hence the heat of hydration is also less. Hence this concrete do not develops any thermal cracks.

Acknowledgement

The success associated with the accomplishment of any task would be incomplete without acknowledging the people who made it possible. I am immensely and sincerely thankful to our project guide B.H.MANJUNATH, Department of Civil Engineering, Sri Siddhartha Institute of Technology Tumkur, under whose guidance this paper has been accomplished flawlessly.