Reactive Powder Concrete Using Fly Ash

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ABSTRACT

As the concrete is a critical material for the construction of infrastructure facilities throughout the world. A new material known as Reactive Powder Concrete (RPC) is becoming available that differs significantly from traditional concretes. In RPC no aggregate used and contains small steel fibres that gives additional strength. RPC were produced in the laboratory fume by fly ash including water-to-binder (w/b) ratio, superplastisizers dosage, curing and the choice of silica fume, on the compressive and flexural to study the effect of replace the silica strength of the hardened materials.Reactive Powder Concrete is an ultra-high-strength and high ductility composite material cause of only fine sand are used in concrete which consumes volume of coarse aggregate. These materials include Portland cement, silica fume, quartz powder, fine sand, high-range water –reducer, water and steel fibres. It is one of the form of Ultra- High-Performance Concretes. RPC produces compressive strength in excess of 200 Mpa range. By using fine steel fibres RPC can achieves flexural strength up to 50 MPa. The energy absorption capacity of RPC is very high because fine aggregate used instead of course aggregate. RPC has compressive strength of 170 to 230 MPa and flexural strength of 30 to 50 MPa, depends on the type fibres used. Replacement of fly ash to silica fume is controls the heat of hydration and cost of concrete.

KEYWORD: *Reactive Powder Concrete (RPC), Silica fume, Fly ash, Compressive Strength, Flexural strength.*

1. INTRODUCTION

1.1 Reactive Powder Concrete (RPC)

RPC is an ultra-high strength and high ductility composite materials with advanced mechanical properties. RPC was developed in the 1990 by Bouygues's laboratory in France. It consists of a special concrete where its microstructure is optimized by precise gradation of all particle in the mix to yield maximum density. It uses extensively the pozzolanic properties of highly refined silica fume and optimization of Portland cement chemistry to produce the highest strength hydrates. RPC is an ultra-high-strength and high ductility composite material cause of only fine sand are used in concrete which consumes volume of coarse aggregate. These materials include Portland, silica fume, quartz powder, fine sand, high range water reducer, water and steel fibres.

These represents a new class of Portland cement based material with compressive in excess of 200 Mpa range. BY introducing fine steel fibres, RPC can achieve high flexural strength up to 50 Mpa. This new materials has compressive strength of 170 to 230 and flexural strengths of 30 to 50 MPa, depending on the type of fibres and admixtures used. The ductile behavior of this material is a first for concrete. The material has a capacity to deform and support flexural load, even initial cracking. These performances are the result improved micro-structural properties of the mineral matrix. RPC is a developing composite material that will allow the concrete industry to optimize material use, generate economic benefits and built structures that are strong, durable, and sensitive to environment.

High Performance Concrete (HPC) is not just a simple mixture of cement, water and aggregates. It contains mineral components and chemical admixtures having very specific characteristic, which gives specific properties to the concrete. The developing of HPC results from the materialization of a new science of concrete, a new science of admixtures and the use of advanced scientific of equipments to monitor concrete micro-structure. HPC has achieved the maximum compressive strength in its existing form of microstructure. However, at such level of strength, the coarse aggregate becomes the weakest link in concrete. In order to increase the compressive strength of concrete even further, the only way is to remove the coarse aggregate.

2. METHODOLOGY

The methodology with respect to objectives are given below,

To check the effect of water dosage, silica fume dosage, steel fibre addition and technical requirements for RPC.

The key factors of mix design will be investigated systematically through a serious of experiments to investigate the influence of individual constituent material properties on overall behaviour, which is close existing practice for normal concrete. These tests includes experiments such as Slump cone test, Compaction factor tests etc.

To check the compressive strength of reactive powder concrete with and without adding Fly Ash tested in CTM by cube prepared with varying percentage of Fly Ash .The standard size of cubes (70 x 70 x 70) mm as per IS specification will be used for compressive strength test. The ages of testing will be 3,7 , 28 days

To check the effect reactive powder concrete with and without Fly Ash on flexural strength of concrete, the beams of (150 x 150 x 700) mm will be used for flexural strength. The ages of testing were 3, 7, and 28 days.

2.1 STANDARD MIX DESIGN

Table no-1

Sr. No.	MATERIAL	QUANTITY (per cu.m)
1.	Portland Cement	955 kg/m3
2.	Fine sand (150-400µ)	1051 kg/m3
3.	Silica Fume	229 kg/m3
4.	Quartz Powder	10 kg/m3
5.	Superplasticizer	13 kg/m3
6.	Steel Fibers	191 kg/m3
7.	Total Water	153 kg/m3

2.2 PERRCENTAGE OF FLY ASH REPLACED

Table no- 2

Sr. No.	MIX	PERCENTAGE OF FLY ASH REPLACED
1.	M	0%
2.	M1	10%
3.	M2	20%
4.	M3	30%

3. RESULTS AND DISCUSSION

Table no- 3 Test results of concrete cube at 3,7,28 days

Sr. no.	mix	Avg comp. strength (Mpa)		
		3 days	7 days	28 days
1	M	71.56	120.68	179.59
2	M1	68.77	115.17	175.17
3	M2	65.10	111.08	155.91
4	M3	60.27	107.14	147.28

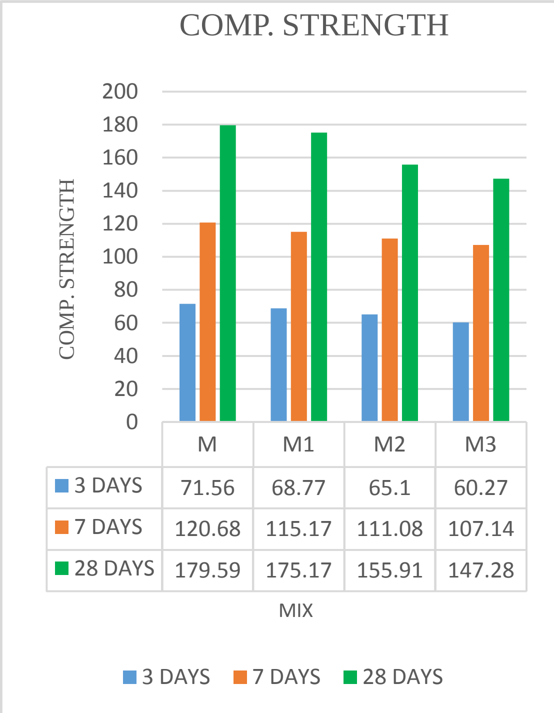

Fig-1 graphical presentation of comp. Strength

From the above table percentage variation in strength of 10% replacement is 2.46%. In comparison of 0% replacement of fly ash.

It is reduced up to 13.19% when fly ash replaced by 20%.

And it is reduced up to 17.99% when 30% fly ash replaced.

It is observed that the compressive strength greatly affected when it is replaced 20% fly ash.

From the figure-1 we can conclude that the variation in compressive strength is not linear.

Table no- 4. Test results of concrete beam at 3,7,28 days

Sr. no.	Mix	Avg. Flexural strength (Mpa)		
		3 days	7 days	28 days
1	M	4.88	7.87	15.60
2	M1	4.56	7.02	15.21
3	M2	4.37	6.61	14.87
4	M3	4.02	6.12	14.70

Effect of fly ash on flexural strength is very small or negligible as compared to compressive strength.

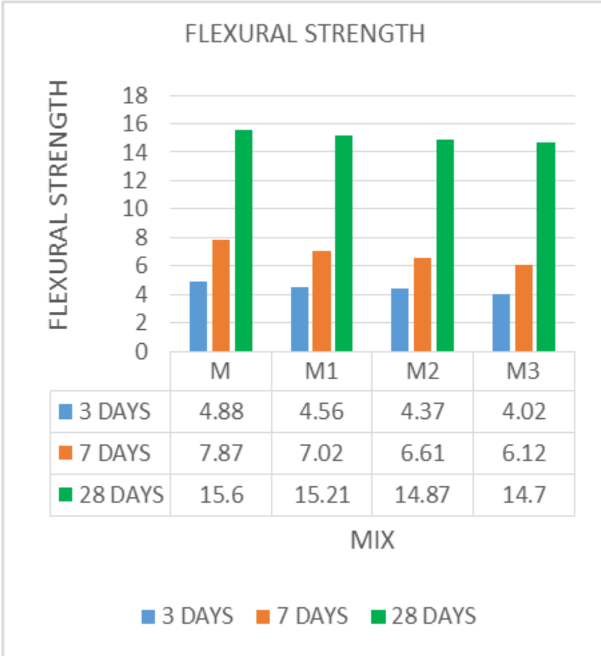

Fig- 2 Graphical representation of flexural strength

4.CONCLUSION

It has immerse potential in construction due to its superior, mechanical and durability properties. RPC has ultra-dense micro structure, giving advantages water proofing and durability characteristics. With increase percentage of Fly Ash in RPC the heat of hydration is decreases also cost is decrease because it affect directly to volume of silica fume which is very costlier content of RPC. Strength is decrease as the percentage of Fly Ash increase, but it is negligible as compared to other benefit. The research shows that use of fly ash replacing to silica fume achieves economy.

Silica fume is major constitute material and it is very costlier because it is not available on large scale in our country. When it is produced on large scale it becomes cheap and hence production of RPC will be economical.

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