Flexural Behaviour of Slabs using Reactive Powder Concrete and Ordinary Concrete

Akhil R[1]
[1]PG Scholar,
Sree Buddha College of Engineering,
Pathanamthitta-689625

Asha Philip[2]
[2]Assistant Professor,
Sree Buddha College of Engineering,
Pathanamthitta-689625

***Abstract*:This paper presents an experimental investigation the flexural behaviour of slabs using Reactive powder concrete and Ordinary concrete , ultimate strength, first crack load and structural integrity. A series of 1x1 m slabs in shear failure plane were tested using optimized Reactive powder concrete (RPC) Shear strength test setup is proposed in which preparation of specimens and testing operation can be made the simplest and at the same time ensures reliable and consistent results. The experimental results show that RPC exhibits ductile failure mode, higher ultimate strength in addition to much improved structural integrity.**

Keywords: ***RPC, Ordinary concrete, Ductile failure, Flexural behaviour***

1. INTRODUCTION

When we say concrete in the building trade, we actually mean reinforced concrete. Its full name is reinforced cement concrete, or RCC. RCC is concrete that contains steel bars, called reinforcement bars, or rebar's. This combination works very well, as concrete is very strong in compression, easy to produce at site, and inexpensive and steel is very strong in tension. The concrete will become hard in a matter of hours, but takes a month to reach its full strength. With the invention of reactive powder concrete (RPC), the use of concrete has increased. RPC with trade name „DUCTAL" was developed in France by researchers Mr.Richard and Mr. Cheyrezy in the early 1990s at Bouygues, laboratory in France. The world"s first RPC structure, the Sherbrooke Bridge in Canada, was constructed in July 1997. RPC is an ultra-high-strength and high ductility cementitious composite with advanced mechanical and physical properties. It is a special concrete where the microstructure is optimized by precise gradation of all particles in the mix to yield maximum density. It extensively uses the pozzolanic properties of highly refined silica fume and optimization of the Portland cement chemistry to produce the highest strength hydrates. RPC is composed of similar modulus of elasticity and size increasing homogeneity reducing differential tensile strain. The material having the largest particle size in RPC is sand. It composed of very fine powders (cement, sand, quartz powder, steel aggregates and silica fume), steel fibres (optimal) and a superplasticizer. The superplasticizers, used at its optimal dosage, decrease the water to cement ratio (w/c) while improving the workability of the concrete. A very dense matrix is achieved by optimizing the granular packing of the dry fine powders. This compactness gives RPC, ultra-high strength and durability. Reactive powder concretes have compressive strengths ranging from 200 MPa to 810 MPa.

II. OBJECTIVES

- To compare the behaviour of RPC and Ordinary concrete specimen which is 1mx1m shear wall
- To compare the elastic modulus through LVDTs test.
- The main objective of this experimental work is to study effect of reactive powder concrete on its various properties.

III. SCOPE

- Investigating the compressive strength of RPC 100 to 800MPa
- Considering 1x1m RPC and Ordinary concrete slab
- To measure the longitudinal deformation LVDTs of 10mm stroke
- Applying the load at the rate of 0.005mm/sec
- Considering Water binder ratio 0.18 and 0.20

IV.LITERATURE REVIEW

This chapter gives a brief review of previous studies conducted in field of RPC.

Santhosh M Muranal This paper studied the stress-strain behaviour of reactive powder. In this work firstly investigated the compressive strength of RPC up to 100 to 800Mpa. Then evaluated the elastic modulus and poissons ratio of RPC specimen. Finally found that using locally available material was possible to produce FRPC with elastic modulus of 51.74 Gpa and poissons ratio of 0.213. The experimental data points on stress-strain curve developed using the expression suggested by Fanella and Naaman for all RPC mixes.

Prof. Dr. Hani M. Fahmi study performance the behaviour and shear strength characteristics of reactive powder concrete (RPC) deep beams subjected to concentrated loads. Seven reinforced deep beams made with RPC were cast and tested. The test variables included the shear span to effective depth ratio, and percentage of silica fume in the concrete. The effect of these parameters on the behaviour of the test beams included deflection, concrete strains, failure mode, and ultimate loads were investigated.

Mr. M. K. Maroliya (2014) This paper highlights the importance of structural performance in response to intense shear loading, a series of direct shear specimens random oriented fibres in shear failure plane were tested using optimized composition of RPC A simple shear strength test setup is proposed which is found to provide reliable and consistent results. The experimental results show that RPC exhibits ductile failure mode, higher ultimate strength and slip capacity in addition to much improved structural integrity.

This enhancement of performance, however, reduces with decrease in size of Specimen.

Anila S, Ashok Mathew (2013) The performance of Reactive Powder Concrete (RPC) is a developing composite material that will allow the concrete industry to optimize the material use, generate benefits by build structures that are strong, durable and sensitive to environment. This study is intended to explore the suitability of providing the reactive powder layer as cover to the normal column (M30).

Dr. Nameer A. Alwash (2012) This paper highlights the importance of This study displays numerically (or theoretically) investigation by using the finite element models for experimental work of composite behavior for hybrid reinforced concrete slab on girder , ordinary concrete in slab and reactive powder concrete in girder, RPC, with steel fibers of different types (straight, hook, and mix between its), tested as simply supported span subjected under two point loading. There is an optimum epoxy layer thickness that gives the best behavior and strength and it is 4mm for the considered specimens in the present study.

V.METHODOLOGY

The properties of the constituents in concrete such as cement, fine aggregate, coarse aggregates are determined. The properties should conform to recommendations given in IS codes .Mix design of M30 grade concrete and reactive powder concrete mix is prepared by using the material properties. Load deflection behaviour and ultimate strength of column, ultimate failure load, vertical deformation, axial strain, cracking pattern were measured for the columns is to be investigated.

A. Mix Design

Table 1
Mix proportion for M30 grade concrete

Sl No.	Materials	Quantities in (kg/m3)	Proportion
1	Cement	425.73	1
2	Fine aggregate	699.89	1.644
3	Coarse aggregate	1114.18	2.62
4	Water	191.58	0.45

VI. RESULTS

B. Tests on Hardened Concrete

Fig.1 Compressive Strength Test on Cube

Fig.2 Split Tensile Strength Test on Cylinder

Fig.3 Flexural Strength Test on Beam

Table II
Compressive Strength of Hardened Concrete Cubes

Age (Days)	Compressive Strength (N/mm^2)	Average Compressive Strength (N/mm^2)
7	20.80	20.83
	21.11	
	20.59	
14	29.95	29.99
	30.39	
	29.64	
28	34.74	34.79
	35.25	
	34.38	

Table III
Split tensile strength on hardened concrete

Age(Days)	Split Tensile Strength(N/mm^2)	Average Split Tensile Strength(N/mm^2)
28	2.93	3.006
	3.21	
	2.88	

Table IV
Flexural strength of hardened concrete

Age	Flexural Strength(N/mm^2)	Average Flexural Strength(N/mm^2)
28	4.48	4.36
	4.24	
	4.36	

Table V
Mix Proportion– RPC Mix without Quartz Powder

Sl No.	Materials	Quantities in (kg/m3)
1	Cement	700
2	Fine aggregate	1230
3	Silica Fume	105
4	Super Plasticizer	70
5	Water	182
6	w/c Ratio	0.26

Table VI
Compressive Strength of RPC mix without Quartz Powder

Age(Days)	Compressive Strength(N/mm^2)	Average compressive Strength(N/mm^2)
7	19.43	19.85
	20.18	
	19.95	

VII.CONCLUSIONS

- Preliminary investigation of coarse aggregate, fine aggregate, cement were conducted and the value obtained as per IS specification.
- Priliminary investigation of coarse aggregate, fine aggregate and cement were carried out.
- Mix design of M30 and M30 reactive powder concrete mix

ACKNOWLEDGEMENT

I am thankful to my guide,Asst.Professor.Asha Philip in civil engineering department for her constant encouragement and able guidance.also I thank my parents.friends etc for their continuous support in making this work complete

REFERENCES

[1] Yin-Wen Chan, Shu-Hsien Chu*(2004)* ".effect of silica fume on steel fiber bond characteristics in reactive powder concrete"
[2] Smit M. Kacha1, Ankur C. *(2014)*"compressive strength of cementitious concrete containing used foundry sand"
[3] M K Maroliya*(2014)* "an investigation on reactive powder concrete containing steel fibers and fly- ash"
[4] Khadiranaikar R.B. and Muranal S. M.*(2013)* ".factors affecting the strength of reactive powderconcrete (rpc)"
[5] Chi-ming TamVivian Wing-yan Tam*(2015)."* microstructural behaviour of reactive powder concrete under different heating condition."
[6] Dr Sravana1 Sarika.P*(2003)* ". studies on relationship between water/binder ratio and compressive strength of high volume fly ash concrete "
[7] Santhosh M Muranal. *(2014)*".sress strain behaviour of reactive powder concrete"
[8] Mr.M.K Maroliya*(2014)* "behaviour of reactive powder concrete in direct shear"
[9] Mr. M. K. Maroliya .*(2013)* ". . size effect on shear behavior of reactive powder concrete containing steel fibres and silica fume"
[10] Prof. Dr. Hani M. Fahmi*(2015)."*. behavior of reactive powder concrete deep beams"