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# *EXPERIMENTAL ANALYSIS OF REACTIVE POWDER CONCRETE USING "KAOLINE"*

***[1]Kedar Desai, [2]Prof. Farhan A Vahora***
***Department of Civil Engineering,***
***L.J Institute of Engineering & Technology, Gujarat Technological University***
***Ahmedabad, Gujarat,380007***

***Abstract — Reactive Powder Concrete (RPC) is a high strength, new generation concrete, formed from a special combination of constituent materials. The composition of reactive powder concrete includes cement (ordinary Portland cement), fine sand, silica fume, quartz powder, and high tensile steel fibres. Reactive powder concrete is grouped under ultra-high performance concrete. This concrete has a very high compressive strength of 200 MPa which can be improved further by introducing steel pellets up to 800MPa. This new family of concrete has improved ductile behaviour with a flexural strength of 25MPa to 40MPaKaolin does not have many cementations properties by itself, but in the presence of water, it reacts with free lime either from cement or from any other source forming higher order hydrated products, which not only enhance strength but also improve durability. In this research paper, analysis of various study conducted on RPC incorporated with various factors has been carried out.***

***Keywords- Ultra High Performance Concret , High Strength concrete, Reactive powder concrete, Kaoline***

## I. INTRODUCTION

There are many types of concrete available, created by varying the proportions of the main ingredients. In this way or by substitution for the cementitious and aggregate phases, the finished product can be tailored to its application with varying strength, density, or chemical and thermal resistance properties Aggregate consists of large chunks of material in a concrete mix, generally a coarse gravel or crushed rocks such as limestone, or granite, along with finer materials such as sand. Cement, most commonly Portland cement, is associated with the general term "concrete." A range of materials can be used as the cement in concrete. One of the most familiar of these alternative cement is asphalt. Other cementitious materials such as fly ash and silica fume, are sometimes added as mineral admixtures either pre-blended with the cement or directly as a concrete component or become a part of the binder for the aggregate. In this work my main concentration will be on Ultra High-Performance Concrete and Reactive Powder Concrete is one of that kind of UHPC.

As more skyscrapers are being built, the demand for the high strength concrete with Compressive strength over 100N/mm$^2$ has been increasing year by year demand for materials with much higher strength will be far larger in the future. The use of supplementary cementitious materials and additives designed to enhance the properties of concrete has grown significantly. The primary focus of this development has been on the achievement of greater compressive strength and it is now no longer possible to refer all concrete as merely concrete.

## II. REACTIVE POWDER CONCRETE

RPC is a high strength, new generation concrete, formed from a special combination of constituent materials. The composition of reactive powder concrete includes cement (ordinary Portland cement), fine sand, silica fume, quartz powder, and high tensile steel fibres. Reactive powder concrete is grouped under ultra-high performance concrete. This type of concrete has enhanced mechanical and durability properties. This concrete has a very high compressive strength of 200 Mpa which can be improved further by introducing steel pellets up to 800MPa. This new family of concrete has improved ductile behaviour with a flexural strength of 25MPa to 40MPa.

These performances are due to the improved microstructure properties and highly discontinuous pore structure. With lots of advantages it is best suitable for pre-stressed and prefabricated structures. The high strength and easiness to produce using the customary industrial tool by casting injection and extrusion make it suitable for prefabricated structural applications. Many researchers around the world have developed Reactive Powder Concretes that could be classified, as Ultra-High-Performance Concrete (UHPC). This technology of producing RPC is covered in one of many patents in the

range of UHPC known as "Ductal". This material has the capacity to take the high load, deform and support the flexural and tensile load, even after initial cracking. Characterization of materials used in RPC has progressed to such an extent that the use of RPC in full-scale structures is distinctively visible on the horizon. Research and observations to date indicate that RPC has the potential to expand its usage in new forms that have been considered impossible until recently.

## III. LITERATURE REVIEW

Various work has been carried out in RPC using Different materials. Here review of papers has been conducted on the mix proportion, mechanical and durability properties of Reactive Powder Concrete (RPC). The various research work carried out are as follows.

**Dr.T.Chandra Sekhar reddy, Kuruva Mahesh** [1] had conducted study on RPC with locally available materials with target strength of 170Mpa. And mainly keep concentration on how concrete changes its microstructural property under different curing conditions. Researchers made mix proportions for UHSC with change in quantity of quartz Powder and River sand and incarnated with steel fiber to avoid brittle failure. They used cube of 70.6 mm X 706 mm X 70.6 mmm and cylinder of 100 mm X 200 mm where cylinder was casted for split tensile test and cube for compressive test. They spotlighted on one major thing that is mixing sequence of RPC which should not be same as it is for conventional concrete. In the conclusion they found out that concrete with 40% replacement and thermal curing gives good and fair result of 171Mpa.

**Khadiranaikar R.B. and Murano S. M** [2] author's study focuses on developing RPC of compressive strength up to 150 MPa. Along with the development of RPC, various factors affecting the strength of RPC are studied. The 100×100×100 mm size RPC cube specimens were cast by varying the constituent materials and cured at both normal and high temperature before testing for their strength. Authors also showed effect of water to binder ratio on compressive strength of RPC (fig 1). The maximum compressive strength of RPC obtained in the present study is 146 MPa at w/b ratio of 0.2 with accelerated curing Researchers also concluded that it is essential to cure concrete under high temperature to get good compressive strength of the concrete.

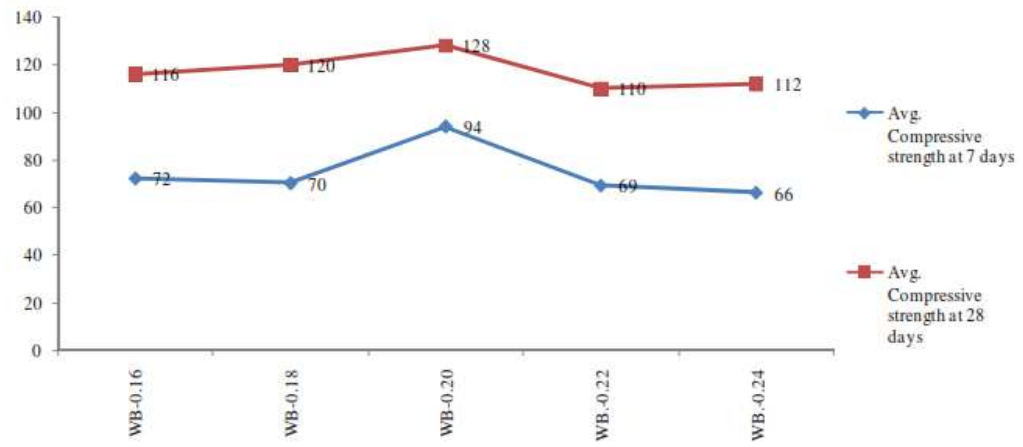


**Fig.1** Effect of water to binder ratio on compressive strength of RPC.

**Pankaj R. Kakad , Ganesh B. Gaikwad** [3] in this paper researcher made RPC in the laboratory fume by fly ash including water-to-binder (w/b) ratio, super-plasticizers 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 in the study they made mix by replacing fly ash from 0 to 30% and test has been done and compressive and flexural strength results has been incorporated in the fig 2 and fig 3 respectively.


**Fig.2** Comparison of compressive strength at 3,7 & 28 days.

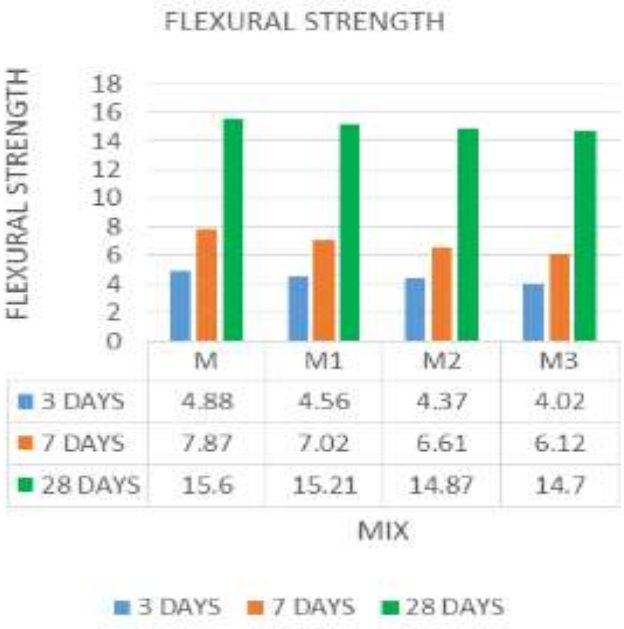


**Fig.3** Comparison of flexural strength at 3,7 & 28 days.

**Sunilkumar K. A., Ramadass S. and Job Thomas**[4]
In this study researcher focused on mortar as a repairing material & the mechanical properties of the high strength cement mortar are described in this paper. They added High strength mortar (HSM) is a repair material that can be prepared in the site with conventional and locally available materials. The use of cement can be controlled by addition of fly ash in the mortar. They said that the tensile strength of mortar can be improved by adding steel fibers. The influence of adding fly ash as a replacement material for the cement and also fibers to enhance the structural tensile strength is studied. In this study they made different mix with combination of fly ash, steel fiber and different w/b ratio. Their experimental test data indicated that the addition of fly ash up to 30 percent will not affect the strength properties. Hence greener repair mortar can be prepared by replacing the cement content up to 30 percent. The addition of steel fibers increases the tensile strength. Hence addition of fibers is also recommended for enhanced structural performance of high strength workable concrete.

**Halit Yazıc** [4] in the effect of curing conditions on compressive strength of ultra-high strength concrete with high volume mineral admixtures author in this study, pulverized fly ash (FA), pulverized granulated blast furnace slag (PS) and silica fume (SF) were quantitatively studied with the incorporation of Portland cement (PC). PC was replaced with FA or PS at specified ratios. Basalt and quartz powder were used as an aggregate in the mixtures. Three different curing methods (standard, autoclave and steam curing) were applied to the specimens.
Test results indicate that high strength concrete can be obtained with high volume mineral admixtures. Compressive strength of these mixtures is over 170 MPa. And regarding method of curing they added that both steam curing and high-pressure steam curing improved the compressive strength of all specimens compared to standard curing. These increments are between 25–63% for steam curing process and 9–61% for autoclaving.

**M.k.maroliya** [5] in this paper authors studied that the use of supplementary cementitious materials and additives designed to enhance the properties of concrete has grown significantly. The production of very high strength normal weight Reactive powder concrete (RPC) requires detailed investigation of a number of factors and the effects of water to cement ratio, curing conditions, compositions and the effect of mineral and chemical admixtures to achieve higher compressive strength. For each trial 6 cubes of 50 X 50 X 50 mm size and 3 beams of 4 X 4 X 16 cm size were cast. The cube

specimens and beam specimens were tested under compression and flexure respectively. With all this author did detailed investigation for A) Influence of silica fume which resulted in that by increasing content of silica we can get more

compressive strength. B) Effect of Super plasticizers which resulted that with low w/b ratio and constant s.p ratio it gives good compressive strength. E) Influence of different curing condition on RPC and result of the same indicated that curing off RPC if done by hot water it will give fair good amount of Compressive Strength.

**C. M. Tam, V. W. Y. Tam and K. M. Ng** [5] authors investigates mechanical and fresh concrete properties of reactive powder concrete, aiming to achieve the optimal conditions for producing reactive powder concrete using local materials by investigating the material composition, curing and heating regimes and the microstructure of reactive powder concrete. Based on the experimental results, it is found that reactive powder concrete with a water-to-binder ratio of 0.2, superplasticizer dosage of 2.5%, 150–600 _m quartz sand cured at 278C in water condition provides the best results in terms of mechanical and composite properties as well as for practical and economical reasons, although heat treatment of the reactive powder concrete can result in a significant increase in compressive strength. t was found that RPC with water-to-binder ratio of 0-2, SP dosage of 2-5% 150–600 um quartz sand cured at 278C in water condition provided the best results in terms of mechanical and composite properties, as well as for practical and economical reasons, although heat treatment of the RPC can result in a significant increase in compressive strength.

## IV. SUMMARY OF LITERATURE REVIEW

To summarize the review of research works on RPC, the following observations are made.

1. A lot of research works were carried out for the production of RPC which is a UHPC, but very few studies precisely compare in detail their mechanical properties with RPC. RPC without fibre was very brittle and to make RPC ductile it is necessary to add fibre. The volume and aspect ratio of fibre to be added should be optimized.
2. The curing regime refers to the sequence of temperature and humidity conditions in which the specimen should be placed which improve the microstructure of the Specimen. A random or wrong curing regime or sudden exposure to extreme temperature may disrupt the formation of C-S-H gel resulting in poor mechanical properties.
3. Reactive Powder Concrete can be interpreted like a concrete (approximately mortar) with the incorporation of 'reactive powder' components to react chemically following casting i.e. the cement by conventional hydration, silica fume through pozzolanic reaction with the resulting calcium hydroxide and the quartz powder by providing dissolved silica for the formation of further C-S-H gel.
4. RPC material tests carried out on standard specimens gives an average value of 180 Mpa with a tensile strength of 10MPa and a flexural strength of 27MPa to 40MPa. The results well complied with results of most of the researchers

## V. CONCLUSION AND FUTURE WORK

In this paper, we proposed to cut down major work has been done in the field of Reactive Powder Concrete from all this I will like to quote one thing that today it is not possible to call all type of concrete as merely concrete as in this only we are eliminating Coarse aggregate to make finer composition of concrete as we all know after some very high stress there is only coarse aggregate who gets fail in first position. This paper will help all the researchers to carter them view and increase understanding in the huge sea of opportunity of World of Reactive Powder Concrete. In the Future work from above literature review's conclusion surely we will be able to carter mix design procedure and different mix proportions to carry out the work with KAOLINE.

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