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Evaluation of the Influence of Reactive Powder Concrete on Compressive Strength and Workability

Subhod Gupta [1], Alok Kumar[2], Rahul Purohit[3]
Professor[1], Student[2,3]
Department of Civil Engineering
R.D Engineering College
Corresponding Author's Email: *alokkumar63@gmail.com[2]*

Abstract

Concrete's poor tensile strength has a number of negative ramifications for its performance as an efficient construction material. This includes the necessity to support rebars as well as the need for thick-walled components that are visually appealing and use a lot of aggregates. In many metropolitan places, the total is becoming increasingly rare. RPC (reactive powder concrete) is a revolutionary technique that overcomes these constraints. To avoid the linked difficulties, avoid aggregation in RPC. RPC is made composed of very fine particles (cement, sand, quartz powder, and silica fume), optional steel fibres, and superplasticizers. The chosen dosage superplasticizer decreases the processability of the W/C ratio in concrete. By optimising the packing of dry, finely powdered particles, an extremely dense matrix is generated. RPC's low porosity makes it extremely durable. RPCs enable the use of reinforced concrete structures composed of elongated structures with enhanced seismic response, and therefore pseudoplastic cold ceramics may be applied in various industries. The research focuses primarily on the workability of reactive powder concrete, which can alter its strength. The primary goal of our project is to investigate the effects on RPC compression strength of modifying or varying the dose of concrete components such as silica fume and super plasticizers.

Keywords: *Tensile strength, RPC compression, Concrete, Elongated structures*

INTRODUCTION

It was known as high-strength concrete in the late 1970s, but it is now recognised as high-performance concrete since it has been demonstrated to be more intense than simply. It outperforms in terms of durability and abrasion resistance. High-performance concrete is a type of technical concrete in which one or more specific attributes have been enhanced through composition and dose selection. In several countries, small particle compaction with concrete (DSP) and reactive powder concrete (RPC) have been promoted as high performance concrete. This novel material family has compressive strength (170 MPa to 230 MPa) as well as flexural strength (30 MPa to 50 MPa). RPC's fractional energy can exceed 40,000 J/m2 when strengthened with steel fibres. Reactive powder concrete (RPC) is an ultra-high-strength cementitious material composed of very fine powder with a maximum particle size of around 800 m. RPC is a very high and very low water and cement content of silica fume characterised by (W/C) ratio, in addition to the lack of traditional coarse aggregate, which is used to manufacture normal and high strength concrete (Cheyrezy Et al., 1995) 1. Use a new generation of high-performance liquefiers to generate workable combinations with low W/C ratios at high dosages. Despite the fact that only a few concrete mix patterns were employed in this investigation (test mix preparation was completed and then aborted by observation).

RPC is made composed of very fine powders (cement, sand, quartz, and silica fume), optional steel fibres, and super plasticizers. When applied correctly, the super plasticizer decreases the water-cement ratio (W/C) while also improving the workability of the concrete. By optimising the particle packing of dry fines, an extremely dense matrix is created. The compressive strength of these reactive powder ketones ranges from 160 MPa to 800 MPa. RPC structural components are resistant to chemical assault, vehicle and container collision, and abrupt dynamic pressures induced by earthquakes. RPC's most crucial attribute is its ultra-high performance. Auramix 400 is a one-of-a-kind next-generation flow system based on long-chain polycarboxylate polymers. This considerably enhances the cement's dispensability. Electrostatic dispersion happens at the start of the mixing process, but the capacity of the cement particles to separate and disperse does not. This device limits the quantity of water that may enter the concrete significantly. Auramix 400 combines water retention and

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processability qualities. It is possible to make high performance concrete and/or concrete.

WORKABILITY

The "workability of concrete" feature has a major role in how green or fresh concrete behaves during the mixing and compacting processes. The four sub-properties of concrete that make up the phrase "workability of concrete" are miscibility, transportability, formability, and compatibility.

Operability, in general, refers to the amount of labour required to compress the concrete in a certain mold. The type of compaction employed and the intricate makeup of the reinforcing steel used in reinforced concrete determine the projected processability of a specific combination. Calculating workability

Measurement of workability:

Slump Test- Through this test, we can determine the water content of a specific set point. In this test, the water content is varied, and in any case, the set point is measured until it reaches the water content that gives the desired set point. This test is not a guide to the proper working ability. For example, rough mixtures cannot be said to have the same machinability as most sand, although they may have the same theft behaviour.

Equipment: Tamping rod, Iron pan to mix concrete, trowels, spatula, slump cone, and graduated cylinder.

Figure1. Slump Cone Test

Procedure- To add four mixtures of 0.50, 0.60, 0.70 and 0.80 W/C ratio. Each mixture requires 10 kg of coarse aggregate, 5 kg of sand and 2.5 kg of cement, to be mixed as follows:

- Mix the dry ingredients thoroughly to obtain a uniform colour and then add water.

- Place concrete in a clean, conical mould, each one-fourth of the height of the mould. Shock absorber rod evenly distributed in the cross section of the shock distribution on each layer 25 times. For the second and subsequent layers, the stuffing bar should penetrate into the lower layer.

- Use a knife or a stuffing die to remove the top of the mould so that the mould is completely filled
- Immediately remove the cone, lift the cone slowly and carefully vertically.
- As soon as the concreting stops, measure the concrete drop, which leads to a decrease.

EXPERIMENTAL PROGRAM

Based on literature studies and material properties studies, RPC compressive strengths have been found for various compositional components. The experiment is as follows.

1. Preliminary investigation: material
2. Design the mixing process
3. Quantification
4. Purchasing materials
5. Casting: mixing process
6. Curing
7. Testing
8. Results Analysis

DESIGN MIX PROPORTION

The table below shows the design mix proportions. While the amount of quartz sand doesn't vary, the amount of fumed silica and the W/C ratio do. The ratio of water to cement and the amount of additional materials affect the flux amount. Below is a table listing the various mix proportions used in this project:

Table 1: Design Mix Proportion

Quartz Sand	Silica Fume	W/C Ratio	Superplasticizer (Trial and Error)
1.5	0.15	0.2 0.25 0.3 0.35 0.4	
	0.2	0.2 0.25 0.3 0.35 0.4	
	0.25	0.2 0.25 0.3 0.35 0.4	
	0.3	0.2 0.25 0.3 0.35 0.4	

QUANTIFICATION

The total amount of material needed depends on the number of bags to be poured. In a project block measuring 70.7 mm × 70.7 mm × 70.7 mm, 16 parts of quartz sand are poured in a ratio so that the total amount of material required is calculated by weight.

SPECIMEN PREPARATION AND CURING

Concrete samples were produced at the concrete laboratory of the Pune Department of Civil Engineering at Sinhgad Institute of Engineering. The method for preparing samples is as follows.

1. Prepare the sample according to the mixing ratio shown in Table 17.
2. Apply oil to the inner surface of the mould to avoid concrete mould connections to the dimensions specified in IS 10086-1982.
3. Place the mould on a flat, solid surface. Put the concrete into three equal layers of concrete in the mould.
4. Move the bucket around the top edge of the mould to ensure that the concrete is symmetrically distributed in the mould. There are 25 strokes on each level of compactness. For layers 2 and 3, the rod must penetrate approximately 25 mm into the underlying layer.
5. Spread the stroke evenly across the cross section of the mould. Close the gap left by the filler bar by gently tapping the sides of the mould.
6. Once the uppermost layer is flattened, dig the surface with a trowel and wrap with Saran to prevent evaporation.
7. Place the mould on a vibration tester for 2 minutes for better compaction. If so, after compaction, fill the room with concrete, compact it and level the roof.
8. After this time, mark the sample and remove it from the mould, unless testing is required within 24 hours. Immerse it in fresh, fresh or saturated lime solution immediately and remove it as soon as possible.
9. The specimen shall not be dried before testing.
10. Mixtures were used in all 48 design combinations, and an average of 3 cubes was cast for each design mix.
11. The size of the mould used was 70.7 × 70.7 × 70.7 mm.

TESTING PROCEDURE

1. Representative concrete samples were used to cast a 70.5 mm x 70.5 mm x 70.5 mm cube.
2. Fill concrete into the mould with a depth of approx. 5 cm. Even distribution through vibration or manual pounding. After topping up,

level the concrete surface flush with the top of the mould and cover with glass to prevent evaporation.

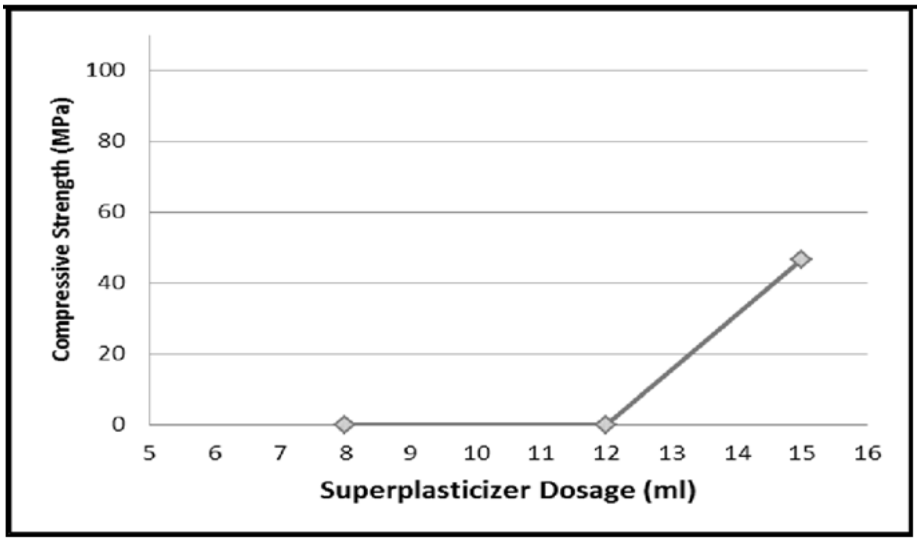
3. The samples were demoded 24 hours later and the blocks were cured in clear water at 27±2°C for 28 days until tested. The test sample was removed from the water immediately after removal and still wet.
4. The bearing surface of the test sample is clean and any loose material is removed from the surface. In the case of a cube, the sample should be placed in the machine so that the cast load cube is not up and down.
5. Align the sample axis with the plate and do not use packaging.
6. The load is applied slowly without impact and increases continuously at a speed of about 140 kg/cm². Until the resistance of the sample collapses against increased load and can not withstand a greater load.
7. The maximum load applied to the sample is then recorded and any abnormal characteristics noticed during the failure are listed in the report.

RESULTS

Results of compressive strength and flow for each proportion and their comparison with super plasticizer dosage.

Table 2: Results of Compressive Strength and Flow for W/C Ratio 0.2 and SF/C Ratio 0.15

Designation	Super plasticizer	Flow	Load	Compressive Strength	Average	Remark
	(ml)	(mm)	(KN)	(MPa)	(MPa)	
A1	8	192	-	-		Dry Mix
A2	8	192	-	-	0	
A3	8	192	-	-		
B1	10	168	260	52		Dense
B2	10	168	240	48	46.67	Compact
B3	10	168	200	40		Mix
C1	6	188	-	-		
C2	6	188	-	-	0	Dry Mix
C3	6	188	-	-		



Compressive strength vs Super plasticizer Dosage

Note- Similarly we have computed the compressive strength as per various mix design proportions as given in table 1

CONCLUSION

- The evaluation of the foregoing facts reveals that the compressive strength is proportional to the superplasticizer dosage, i.e., the strength increases with the superplasticizer dose.
- Increasing the superplasticizer content improves the utilisation of the Furthermore, the W/C ratio increases.
- The SF/C ratio has no effect on the compressive strength of the material.
- According to the literature, RPCs (up to 15 to 0.2) must have a low W/C ratio, but the needed amount of superplasticizer is rather considerable and hence uneconomical.
- For water-cement ratios of just 2 and 0.25, the flow depicted reflects diffusion rather than material mixing.
- The general conclusion of the study is that for the best outcomes, a W/C ratio of 3 for a silica to cement ratio of 0.2 and a superplasticizer dose of 8 to 10 ml should be used.

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