BOND STRENGTH OF REACTIVE POWDER CONCRETE TO GFRP REINFORCEMENT

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Abstract:-**A Reactive powder concrete is the new material which have cement based content and high ultra-performance concrete with good mechanical properties and good durability. The reactive powder concrete have major difference between the conventional concrete is that no coarse aggregate is involved in reactive powder concrete, quarts in fine form, with more dosage of silica fumes and superplasticizer are used instead. Heat treatment is used in reactive powder concrete to improve the performance of the concrete. RPC has been used in direct pull out specimen method. Results shows that the behavior of plain matrix and perfectly to the brittle nature whereas RPC contain fibers maintained with the load carrying capacity of large deformation and prevented cracking, disintegration of matrix and splitting. Fiber-reinforced polymer (FRB) bars are under direct pullout conditions in concrete. The bond failure of FRP bars was differ in substantially and deformed steel bars were found in the damage of resin rich surface of the bar when direct pullout test takes place. Carbon fiber-reinforced polymer and glass fiber-reinforced polymer bars are very similar with Bond strength are developed and expected from deformed steel bars under same testing conditions. The fundamental difference between steel and FRP materials are highlighted during the load slip curves. This type of curve the shape surface characteristics, and the diameter of the bar as well as the testing arrangement of concrete is influence in bond strength of the bars.**
Keywords: *RPC, ultra-high-performance concrete, durability, interaction, FRP bars, bond strength,*

I. INTRODUCTION

Reactive Powder Concrete (RPC) is an emerging modern composite matter with the aim of allowing the concrete manufacturing and production to optimize material utilization. Silica is the one of the main ingredient of reactive powder concrete. The Reactive Powder Concrete has compressive strength which ranges from 200MPa to 800MPa. With the help of reactive Powder Concrete produces special cost-effective benefits and help building structures which are very strong, tough, and friendly with the environment. Some decades back structural engineers preferred HPC. The acronym HPC stands for high performance concrete. It is an uncomplicated blended of water cement and other collective components. It also encloses unique mineral components along with chemical admixtures. These mixtures have very precise characteristics. This specific uniqueness present in HPC gives a defined property to the concrete. Several laboratory tests have proved that Reactive Powder Concrete (RPC) is much better than High-Performance Concrete (HPC). RPC was manufactured from very fine powders of ingredients like silica fume, sand, quartz powder, cement, steel fibers and super plasticizer. A very solid equation and matrix were attained by the coarse packed in dried form of powder. This gives RPC structures extra durability

II. GLASS FIBRE

Glass fibre is the fibre made up of isotropic material and based on the form of silica with addition of oxides, calcium, iron, boron, sodium, and aluminum. It is an elastic in nature up to the exhibit negligible creep and failure under controlled dry condition.Glassfibre are classified as follows: E-glass (electrical glass), A-glass (window glass), S-glass, AR-glass (corrosion resistance glass)
The application of fibers are also improves the moisture production and process ability. A and C type glasses are used to produce high specialized projects in strengths.

III. BOND STRENGTH

Bond strength between the steel reinforcement and steel is more considerable importance. The perfect bond strength of the existing concrete and steel reinforcement is one of the basic assumption of concrete. The Bond strength arises from the friction and adhesion between the reinforcement of concrete is also one of the factors affecting the bond strength. **3.1Pullout test:**

A pullout test used to measures the force required to pullout a cast-in steel rod with an embedded enlarged end of the concrete. Due to the shape of the rod assembled in pulled out with a lump of concrete in the shape of the cone. The pull-out strength is find out by the ratio of the force of the area and frustum, the strength being close to that the strength of shear in concrete. The pull-out strength relates with the compressive strength of cubes or cylinders for a wide range of age and curing cond .

3.2 Testing procedure for pullout test:

Pullout test are used in the assessment of bond performance and steel reinforcing bars in concrete. The main aim of bond tests is to obtain the bond-slip relationship between the loads and free ends of bars subjected to a pullout load, these factors were affected expected to have a bond behavior of FRP bars because FRP material are strongly anisotropic and the mechanical properties of the steel bars. A proper evaluation of these factors on bond development is crucial to the materials cooperate with the concrete in structural members and the estimation of the adequate anchorage lengths and casting, the FRP bars were marked properly and the embedment length would lie in the center of the concrete cube. The embedment lengths were designed in different types of the bar diameter to facilitate the difference between bars and diameters. The both ends of the bar in concrete cube were covered with several layers of cling film in the form of noncontact (deboned) areas between the bar and concrete. The bars were vertically positioned in 100 mm cube mould, and concrete was cast the whole bar

IV. OBJECTIVES & SCOPE

4. Objective:

The objectives and scope derived after carried and thorough study of literature review as follows.

To evaluate the mechanical properties like Compressive strength and Modulus of elasticity**.** To evaluate the bond stress versus slip by conducting direct Pullout test

4.1 Scope:

To study on the characteristics and properties of the RPC materials. To propose appropriate mix of the reactive powder concrete. To study on bond strength of the RPC to GFRP material by direct pull-out test.FEM modelling for bond versus slip stress.

V. Materials collected :

Fig.1 Fine quartz

Silica fume:

Fig.2 silica fume

Super-plasticizer:

Fig.3 super plasticizer

VI. METHODOLOGY

The materials were weighed and placed in a 0.01m^{3}and 0.0157 m^{3}capacity horizontal pan mixer in the order: cement, quartz. The materials were first dry mixed and the water previously mixed together was added to a rotating drum after that the materials had been mixed properly and the concrete in wet appearance. The concrete was mixed for 5minutes and then cast into steel cube moulds for tests. The specimen were then compacted on a vibrating table and subsequently covered with a damp hessian. They were demoulded at 1 day, the concrete had set and placed in a normal curing at 7, 14, 28 days.

VII. RESULTS

The values observed during the cube and cylinder tests are given in the following tables and charts.

Fig.1Typical tensile testing of FRP bar

Fig.1 Stress-strain relationship curve of FRP bar

Fig.2

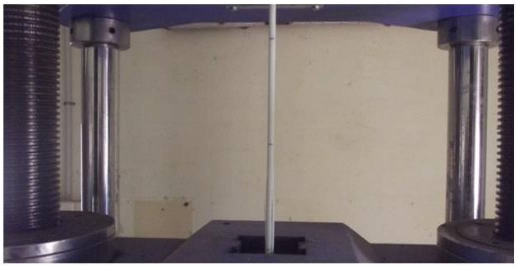
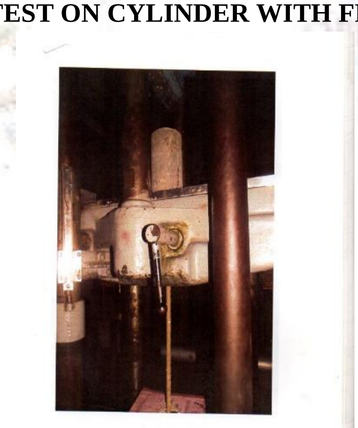


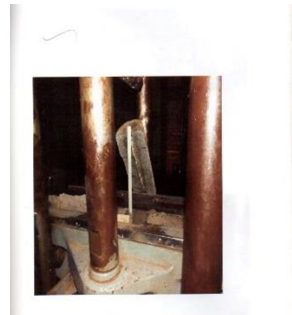
Fig.2Stress-strain relationship curve of FRP bar

Specimens:

PULL OUT TEST ON CYLINDER WITH FRP ROD

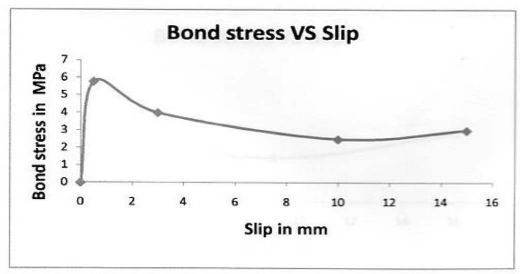


TESTING OF CYLINDER WITH FRP ROD

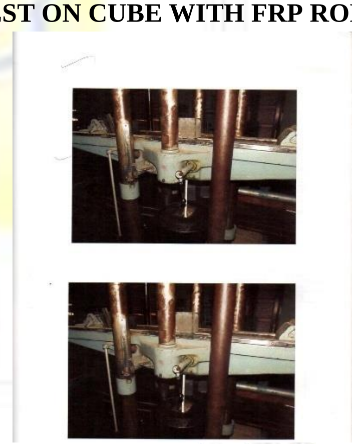


PULL OUT TEST ON FRP ROD-(CYLINDER)

SL.NO	LOAD IN (TONNE)	MSR	VSR	AVG.BOND STRESS, τ_{ba} (Mpa)	SLIP IN (MM)
1	0.2	2	10	0.364	2.2
2	0.4	4	6	0.728	4.12
3	0.6	6	12	1.1	6.24
4	0.8	9	8	1.45	9.16
5	1	10	16	1.82	10.32
6	1.2	11	10	2.2	11.2
7	14	12	4	2.55	12.08
8	1.6	13	2	2.91	13.04
9	1.8	15	8	3.275	15.16
10	2	17	2	3.64	17.04
11	2.2	18	12	4	18.24
12	2.4	19	16	4.36	19.32
13	2.6	21	10	4.73	21.2
14	2.8	23	4	5.1	23.08
15	3	24	8	5.46	24.16
16	3.2	25	12	5.82	25.32



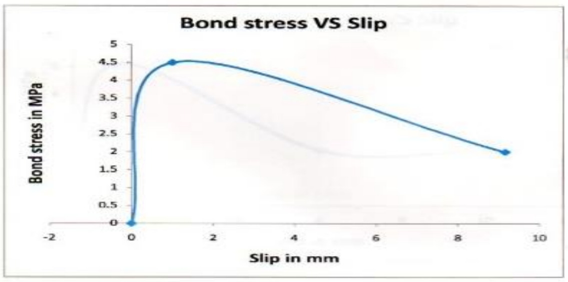
PULL OUT TEST ON CUBE WITH FRP ROD



PULL OUT TESON FRP ROD-(CUBE)

Tabulation. 7.7 Cube - Normal curing (Sand coated)

Sl.NO	LOAD IN TONNE	MSR	VSR	AVG.BOND STRESS, τ_{bu} (Mpa)	SLIP IN MM
1	0.2	2	8	0.637	2.16
2	0.4	3	2	1.27	3.04
3	0.6	4	10	1.91	4.2
4	0.8	6	16	2.54	6.32
5	1	8	6	3.185	7.12
6	1.2	8	4	3.82	8.08
7	14	9	8	4.46	9.16



VIII. CONCLUSION

In this chapter, the salient conclusions are presented based on the experimental study. The bond stress of threaded GFRP reinforcement also exhibits the same value. The bond stress of sand coated GFRP reinforcement for cylinder specimen on steam curing condition gives 28% higher stress value normal curing condition. The bond stress for sand coated GFRP reinforcement for cube specimen and steam curing condition 53% higher stress value normal curing condition. It is observed that the action bond stress at failure is influenced by splitting and other secondary effects.

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