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Influence of Granite Powderin the Properties of Fiber Reinforced Selfcompacting Concrete

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Abstract— In this investigation, the workability of partially replacing granite waste in fiber reinforced self-compacting concrete is studied and their characteristic is compared. The mix proportion is obtained as per the guidelines given by European Federation of producers and contractors of specialist's products for structure (EFNARC). SCC mixes are produced by replacing the cement with 10%, 20% and 30% of granite waste and with addition of glass fiber of 0.2%, 0.4% and 0.6% to the SCC concrete. The w/p ratio used in this investigation is 0.4. Super plasticizer used in this study is Conplast SP430 and its dosage is 0.5 % to obtain the required SCC mix. Fresh concrete properties are checked by conducting the workability tests such as Slump Flow, T50 Slump Flow, L-Box, U-Box and V-Funnel tests. While there is abundant research information on ordinary confined concrete, there are little data on the behavior of Self-Compacting Concrete (SCC) under such condition. Due to higher shrinkage and lower coarse aggregate content of SCC compared to that of Normal Concrete (NC), its composite performance under confined conditions needs more investigation. This project has been devoted to investigate and compare the workability nature of conventional concrete with SCC. The influencing parameters includes concrete compressive strength, percentage of granite powder replaced with cement content and percentage of glass fiber added.

Keywords— Self Compacting Concrete, Conplast SP430, Granite powder, Glass fiber

INTRODUCTION

Self-Compacting Concrete (SCC) is a newly introduced concrete type, therefore, only limited experience is provided by its appropriate composition. Construction quality of normal concrete structures highly depends on the vibrating time during casting, and in a liquid vibration, this may lead to inferior quality of concrete. However, this drawback can be eliminated if SCC is employed. Itisabletoflowunderitsownweight,completely filling form work and achieving full compaction, even in the presence of congested reinforcement. SCC is a high performance concrete that can flow into a place under its own weight and achieve good consolidation and doesn't exhibit defects due to segregation and bleeding. The hardened concrete is dense, homogeneous and has the same engineering properties and durability as traditional vibratedconcrete. A lack of conformation regarding in-place properties and structure performance of SCC is one of the main barriers to its recognition in the construction industry. Self-compacting concrete offer sarapidrate of concrete placement,with faster construction times and ease of flow around congested reinforcement.The fluidity and segregation resistance of SCC ensures a high level of homogeneity, minimal concrete voids and uniform concrete strength, providing the potential for a superior level offinis hand durability tothe structure.SCCis often produced with low water-cement ratio providing the potential for high early strength, earlier de-molding and faster use of elements and structures.

I. MATERIALS

A. Cement

The OPC 53 grade of cement is used. 53 Grade cement are used for fast paced construction were initial strength is to be achieved quickly. 53 Grade cement has fast setting compared to 43 grade cement. 53 Grade attains 27 mpa in 7 days compared to 23 mpa by 43 grade cement.

TABLE I CHEMICAL COMPOSITION OF GGBS

CaO (%)	SiO_2 (%)	Al_2O_3 (%)	Fe_2O_3 (%)	MgO (%)	SO_3 (%)
60-67	17-25	3-8	0.5-6	0.1-4	1-3

B. Granite Powder

Granite Powder (GP) is industrial byproducts generated from the granite polishing in powder form. These byproducts are left largely unused and are hazardous materials to human health because they are airborne and can be easily inhaled. Since granite powder's chemical composition (consists of CaO, SiO2, Al2O3, MgO & Fe2O3) is similar to that of cement, it is used as a partial replacement of cement.

C. Coarse Aggregates

Coarse Aggregates are the most mined materials in the world. Here 10mm aggregates are used since it enhances the passing ability of self-compacting concrete. The 20 mm aggregate can also be used but the concrete fluid cannot be used in confined spaces. The specific gravity of aggregate was resulted as 2.75 and fineness modulus was 6.79.

D. Super Plasticizer

CONPLAST SP 430 was used for mixing. In order to achieve flow ability in self-compacting concrete, water content has not to be increased since it will cause segregation and bleeding instead super plasticizer has to be added.

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E. Glass Fiber

Glass fiber will increase the tensile strength of concrete. In this project, 6mm long glass fibers are used.

F. Water

Water is the most important component of a concrete mix. The percentage of water content added will influence the percentage of super plasticizer to be added.

II. LITERATURE REVIEW

Several literatures have been studied regarding the self compacting concrete and the changes in their properties when fiber and granite powder are used.

Hajime Okamura and Masahiro Ouchi (2003) investigated the properties of self-compacting concrete. The coarse aggregate and fine aggregate content is fixed at 50% and 40% of the solid volume and mortar volume respectively. The water powder ratio in volume is assumed as 0.9-1, depending on the properties of the powder. The super plasticizer dosage and the final water powder ratio are determined so as to ensure self compactability.

Frances Yang (2004) studied on Self-Consolidating Concrete and based on his investigations, he concluded that the technology behind creating SCC, including its components and mix proportioning techniques. The highly flow able nature of SCC is due to very careful mix proportioning, usually replacing much of the coarse aggregate with fines and cement, and adding chemical admixtures. While there is no set definition for SCC yet, for now the concrete construction industry generally follows certain methods of measuring mix properties to define an SCC.

Das D, Gupta V K and Kaushik S K (2006) investigated on Effect of maximum Size and Volume of Coarse Aggregate on properties of SCC and concluded based on their experimental investigations that to achieve the self compacting properties, the mix should contain a lower volume of coarse aggregate. It is difficult to develop self compacting concretes with a coarse aggregate content higher than 45% or lower than 15% of the total aggregate. The probabilistic model developed in this study allows the mix designer to design on the maximum allowable coarse aggregate content of a specific maximum size and gradation, for a giving blocking tolerance.

Bouzouba N, Lachemi M (2011) carried on Self-compacting concrete incorporating high volume of class F fly ash: Preliminary results and concluded that. In recent years, Self-compacting concrete (SCC) has gained wide use for placement in congested reinforced concrete structures with difficult casting conditions. The use of fine materials such as fly ash can ensure the required concrete properties. The SCCs developed 28-day compressive strengths ranging from 26 to 48 MPa. The results show that an economical SCC could be successfully developed by incorporating high volumes of Class F fly ash.

Dr.Muthupriya.P, Ms.P.NandhiniSri (2012) investigated on strength and workability character of SCC with GGBS, FA and SF and concluded that the use of mineral admixtures improved the performance of SCC in fresh state and also avoided the use of VMAs

Dr.T. Felix Kala (MAY 2013) studied about the effect of Granite Powder on Strength Properties of Concrete. The experimental study of using locally available granite powder as fine aggregate and partial replacement of cement with admixtures in the production of HPC with 28 days strength to the maximum of 60 MPa. The influence of water cement ratio and curing days on mechanical properties for the new concrete mixes were premeditated. The percentage of granite powder added by weight was 0, 25, 50, 75 and 100% as a replacement of sand used in concrete and cement was replaced with 7.5 % silica fume, 10% fly ash, 10% slag and the dosage of super plasticizer added 1% by weight of cement. The test results show clearly that granite powder of marginal quantity, as partial sand replacement has beneficial effect on the above properties. The highest strength has been achieved in samples containing 25% granite powder together with admixtures. Based on the results presented in this paper, it can be concluded that concrete mixture can be prepared with granite powder as an additive together with admixtures to improve the strength of concrete structure.

III. MIX DESIGN

Self-compacting concrete is recently developed concrete and therefore there is no strong guidelines to follow to attain the required type concrete. The guidelines provided by EFNARC (European Federation of National Associations Representing For Concrete). The mix design adopted is used for the mix production and it's slump value is checked and then the mix design is confirmed for further preparation

A. Mix Proportions

- Cement = 669.76 kg/m^3
- Fine aggregate = 815.33 kg/m^3
- Coarse aggregate = 627.65 kg/m^3
- Water cement ratio = 0.4
- Super plasticizer = 3.3488 lit/m^3
- Glass fiber = 1.3395 kg/m^3

Fig. 1. Mixing of Concrete

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IV. TESTS CONDUCTED ON CONCRETE

Self Compacting Concrete must possess three main characteristics. They are

1. Passing ability
2. Filing ability
3. Segregation resistance

TABLE II TESTS CONDUCTED

TEST CONDUCTED FOR	TEST TYPE
Passing ability	L - Box, U - Box
Filling ability	Slump flow, T_{50} cm slump flow, V-Funnel
Segregation resistance	V- Funnel

Fig. 2. U- box test of concrete

V. RESULTS AND DISCUSSION

Various test are conducted on concrete having different proportions of fiber and granite powder and the results were analyzed.

A. Fiber Concrete

When glass fiber content in the concrete fluid is increased, the flow ability of the concrete was reduced. The less amount of fiber, more the flow ability of the concrete.

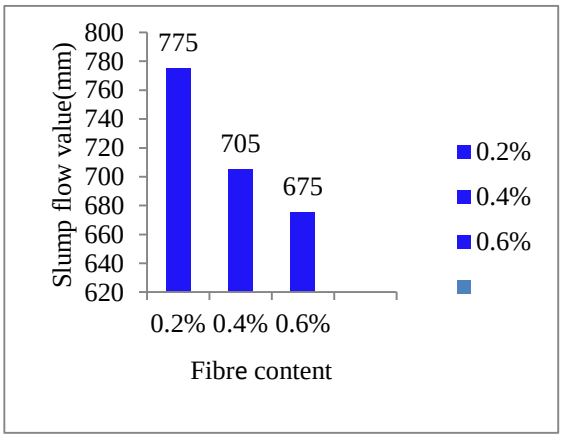

Fig. 3. Slump flow (mm) variations for 10% of cement replaced by granite powder in concrete.

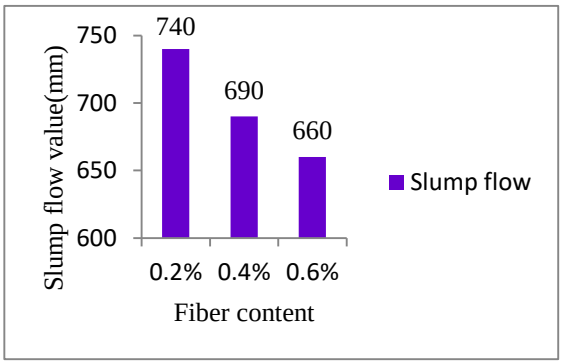

Fig. 4. Slump flow (mm) variations for 30% of cement replaced by granite powder in concrete.

VI. GRANITE CONTENT

When granite powder content in the concrete fluid is increased, bleeding and segregation of concrete constituents occurs . Limited percentage up to which cement to be replaced by granite powder is 30%.

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TABLE III RESULTS OBTAINED

S No	Granite Powder Replacement (%)	Fiber Content (% Of Cement Content)	TESTS CARRIED OUT					
			SLUMP FLOW (mm)	T_{50} SLUMP FLOW (sec)	J – RING (mm)	L – BOX (mm)	U – BOX (mm)	V-FUNNEL (sec)
1	0	0.2	790	3.2	620	0.995	18	5.4
2	10	0.2	775	4.5	605	0.960	12	6.2
3	20	0.2	765	5.25	590	0.930	9	6.95
4	30	0.2	740	5.4	575	0.890	7	8
5	0	0.4	715	3.5	610	0.980	15	5.7
6	10	0.4	705	4.4	595	0.955	10	6.4
7	20	0.4	695	5.2	585	0.925	8	6.8
8	30	0.4	690	5.7	575	0.885	6	7
9	0	0.6	680	4.4	605	0.965	12	5.9
10	10	0.6	675	5.3	595	0.925	9	6.6
11	20	0.6	665	5.5	590	0.905	7	6.92
12	30	0.6	660	6.1	580	0.875	5	7.3

VII. CONCLUSION

- The flow ability is decreased when the percentage of fiber added is increased.
- The increase in addition of granite powder causes bleeding and segregation in concrete i.e., the water doesn't mix well with concrete mix.
- The workability is improved when fiber is added.
- Self-compacting concrete can be used for speedy construction as it sets rapidly.
- Granite powder reduces the workability when added in large amount.
- Super plasticizer acts a governing agent for setting time of concrete. If 2% super plasticizer of cement content is added, the concrete sets within 10 minutes.
- Since granite powder, an industrial waste is used, an economic product is obtained.

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