Use of Marble Powder and Fly Ash in Self Compacting Concrete

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Abstract

In Recent years, Self Compacting Concrete (SCC) has gained a wide use for placement in congested reinforcement concrete structures where casting condition are difficult and in high rise buildings where pump ability properties are required. SCC used where, Fresh property of concrete required as a high fluidity and good cohesiveness. The project can lead to use of marble powder as a industrial waste and Fly ash as a pozzolana material. The established benefits substitution marble powder and fly ash by cement to make concrete such as economic, saving landfill, Reduce CO2 emission by the use of less cement. The amount of marble powder as a waste material is significantly of increasing. Therefore the utilization of marble powder in Self compacting concrete as filler material, The main objective of study is the behavior of SCC with marble powder and fly ash and understand the effect on fresh property, Harden property and Durability and also investigate the compatibility of marble powders in SCC along with chemical admixture such as super plasticizers and also Considerable enhancement in fluidity, hardened property and Durability of SCC by substitution of cement by Marble powder and Fly ash.
Keywords: Fly Ash , Fresh And Harden Property, Marble Powder, SCC

I. INTRODUCTION

SCC has been considered as a great development in construction since its first developed in japan. The high fluidity is main property of SCC so that it can be placed under its self-Weight without vibration. In order to obtain SCC of high flowability without segregation or bleeding during the transportation or placing, the use of high powder content, super plasticizers and viscosity modifying admixtures seems a good solution. However, the cost of such concrete is significantly higher. The use of mineral additives such as silica fumes (SFs), Fly ash (FA) and ground granulated blast-furnace slag (GGBFS) could reduce material cost and enhance the self-compatibility. Several studies have shown that natural pozzolana have been widely used as a substitute for Portland cement in many applications because of its advantageous properties which include cost-reduction, reduction in heat evolution, decreased permeability and increased chemical resistance. Marble powder (MP) which is an inert material obtained as an industrial by-product during sawing, shaping, and polishing of marble has also successfully been used as an addition in SCC . Marble powder used as mineral addition of cement is reported to improve some properties of fresh and hardened self-compacting concrete (SCC).

II. LITERATURE SURVEY

1) Okamura and Ozava developed slump flow, Funnel flow, L box and U box test apparatus for Passing ability and filling ability and Okamura , Hajime they are explain Self compacting concrete performance to achieve high strength during its harden.
2) A.S.E. Belaidi1 and L.Azzouz2 was investigated examine the effect of substitution of cement with natural pozzolana and marble powder on the rheological and mechanical properties of self-compacting mortar (SCM) and self - compacting concrete (SCC). Ordinary Portland Cement (OPC) was partially replaced by different percentages of pozzolana and marble powder (10–40%). The results indicate an improvement in the workability of SCC with the use of pozzolana and marble powder.
3) Ilker Bekir Topçu1, Turhan Bilir2 was presented that MP has replaced binder of SCC at certain significantly increase. After then, slump-flow test, L-box test and V-funnel test are conducted on fresh concrete . The effect of waste MP usage

as filler material on capillarity properties of SCC is also investigated. According to the test results, Increase flowability with increase MP in Self compacting concrete.

III. CONSTITUTE MATERIAL

A. Cement:

Cement can be defined as material having adhesive and cohesive properties which make it capable of bonding material fragments into a compact mass. Cement is the most important ingredient in concrete. Different brands of cement have been found to possess different strength development characteristics and rheological behavior due to the variations in the compound composition and fineness. For the present investigation, ordinary Portland cement (chettinad) of 53 grade conforming to IS 12269-1987 was used.

B. Course Aggregate:

The coarse aggregate used in the investigation is crushed stone aggregate passing through 16mm sieve. The aggregate occupy 70%-80% of the total volume normal concrete. But self-compacting concrete have only 50% of total volume of concrete. Coarse aggregate shall comply with the requirement of IS 383.

C. Fine Aggregate:

The fine aggregate used in the investigation is clean river sand and conforming to zone II. The sand was first sieved through 4.75mm sieve to remove any particles greater than 4.75mm. Fine aggregates shall conform to the required of IS 383.

D. Admixtures:

The most important admixtures are the super plasticizers (high range water reducers), used with a water reduction greater than 20%.Admixture conforming to IS 9103.

E. Mixing Water:

Water conforming to Standards should be used in SCC mixes. Where recycled water, recovered from processes in the concrete industry, is used but should conform the specifications.

F. Fly Ash:

Fly ash is a fine inorganic material with pozzolanic properties, which can be added to SCC to improve its properties. However the dimensional stability may be affected and should be checked. Fly ash conforming to IS 3812.

G. Marble Powder:

The advancement of concrete technology can reduce the consumption of natural resource and energy source and lessen the burden of pollution on environment .Presently Large amounts of marble dust are generated in natural stone processing plants with an important impact on environment and humans. This project describes the feasibility of using the marble dust in concrete production as partial replacement of cement. In INDIA, the marble and granite stone processing is one of the most thriving industry the effects if varying marble dust content on the physical and mechanical properties of fresh and hardened concrete have been investigated.

IV. FRESH PROPERTY OF SCC

The following properties are defined in accordance with the EFNARC guidelines which are acceptable worldwide:

A. Filling Ability:

The ability of SCC to flow into and fill completely all spaces within the formwork, under its own weight. Filling ability is generally measured by slump flow (Fig .4a) or V-Funnel test (Fig .4b). As per EFNARC guideline, Flow must be varies from 650 to 800mm and Time required to empty V Funnel must be varies 6 sec to 12 sec.

B. Passing Ability:

The ability of SCC to flow through tight openings such as spaces between steel reinforcing bars without segregation or blocking. It is normally measured by U-box (Fig. 4c). As per EFNARC guideline, H2/H1 must be varies from 0.80 to 1.0.

C. Segregation Resistance:

The ability of SCC to remain homogeneous in composition during transport and placing.

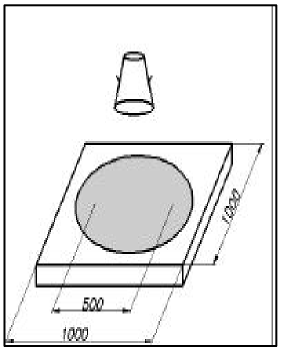

Fig. 1: Slump Flow Test

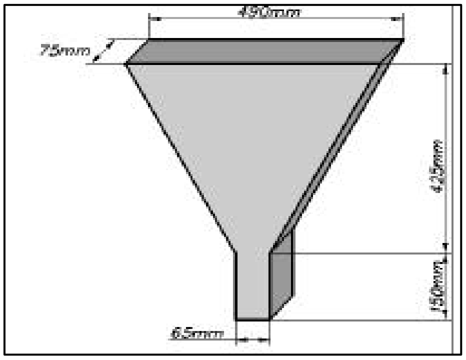

Fig. 2: V Funnel Test

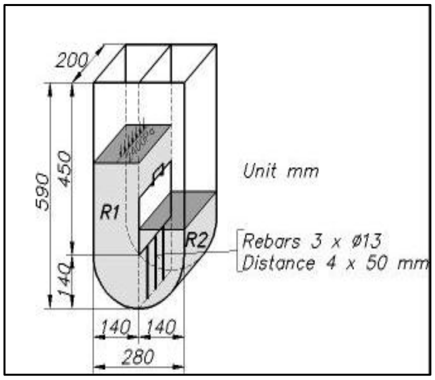

Fig. 3: C: U- Box Test

V. HARDEN PROPERTY OF SCC

Compressive Strength is the average of at least three standard cured strength specimens made from the same concrete sample and tested at the same age. In most cases strength requirements for concrete are at an age of 28 days of curing. The concrete cubes, after 28 days were tested for their compressive strength in the following manner. After cleaning of bearing surface of compression testing machine

Split Tensile Strength is consists of applying a diametric compressive force along the length of a cylindrical specimen. This loading induces tensile stresses on the plane containing the applied load. Tensile failure occurs rather than compressive failure. Plywood strips are used so that the load is applied uniformly.

A beam test is found dependable to measure flexural strength properties of concrete and same is applied for Self Compacting concrete (SCC). In the test comparison is made between Ordinary Cement Concrete (OCC) and Self Compacting concrete (SCC) by taking the same size of beam 10x10x50cm. Test specimens of Self Compacting concrete (SCC) and Ordinary Cement Concrete beam.it was cured into water for 28 days and then tested it.

VI. MIX DESIGN

An example of a procedure for efficiently designing SCC mixes is shown below. It is based on a method developed by Okamura. The following key parameters are to be assumed for SCC:

1) Designation of desired air content (mostly 2 %)
2) Determination of coarse aggregate volume
3) Determination of sand content
4) Design of paste composition
5) Determination of optimum water: powder ratio and super plasticizers dosage in mortar
6) Finally the concrete properties are assessed by standard tests.

VII. MIX DESIGN PROPORTION

Three types of specimens to be used for carry out hardened properties of concrete named cubes, beams and cylinders. Following table shows the mixing proportions of different mixes:

Table -1
Mix Design Proportion M-30

Mix Design Proportion M-30										
Sr.No.	Type of Mix	W/P ratio	Total Binder (kg/cum)	Cement (kg/cum)	Flyash (kg/cum)	Marble powder (kg/cum)	Coarse aggregate (kg/cum)	Fine aggregate (kg/cum)	Water (liter/cum)	S.P.(1%) (kg/cum)
1	M-30(0% MP + 25% FA)	0.36	500	375	125	0	741.69	955.12	180	5
2	M-30(5%MP + 25% FA)	0.36	500	350	125	25	741.69	955.12	180	5
3	M-30(10%MP + 25% FA)	0.36	500	325	125	50	741.69	955.12	180	5
4	M-30(15%MP + 25% FA)	0.36	500	300	125	75	741.69	955.12	180	5
5	M-30(20%MP + 25% FA)	0.36	500	275	125	100	741.69	955.12	180	5
6	M-30(25%MP + 25% FA)	0.36	500	250	125	125	741.69	955.12	180	5

VIII. FRESH PROPERTIES OF CONCRETE

Table – 2

Sr. No.	Type of Mix	Slump (mm)	T50cm Slump Flow (sec)	V-Funnel (sec)	L- Box {h2/h1)	U- Box {h2/h1) (mm)
		600-750 mm	<6 sec.	8-12 sec.	0.8-1	0 to 30mm
1	M-30(0% MP + 25% FA)	655	4.5	10.8	0.82	28
2	M-30(5%MP + 25% FA)	660	4.1	9.6	0.85	26
3	M-30(10%MP + 25% FA)	675	3.7	8.7	0.88	23
4	M-30(15%MP + 25% FA)	695	3.2	8.2	0.90	22
5	M-30(20%MP + 25% FA)	702	3.1	7.9	0.92	19
6	M-30(25%MP + 25% FA)	705	3.0	7.5	0.92	17

IX. HARDEN PROPERTY OF CONCRETE

Table -3
M-30

M-30				
Compressive Strength of cubes (Target mean strength 38.25mpa)				
Sr No	Type of Mix	7 days	14 days	28 days
1	Mix-1(0%MP+25%FA)	28.74	35.63	43.78
2	Mix-2(5%MP+25%FA)	27.26	33.62	41.40
3	Mix-3(10%MP+25%FA)	25.70	31.40	38.59

4	*Mix-4(15%MP+25%FA)*	*23.70*	*28.81*	*36.30*
5	*Mix-5(20%MP+25%FA)*	*22.52*	*27.33*	*33.70*
6	*Mix-6(25%MP+25%FA)*	*20.59*	*25.62*	*31.18*

X. CONCLUSIONS

- The Use of marble powder and fly ash by substitution to cement has no negative effect of workability of SCC.
- In Fresh property such as Filling ability and Passing ability is increase by Use of 10% Marble Powder and 25% Fly Ash by Substitution by cement in binder material.
- Increase of Marble powder in SCC increase slump flow.
- The increase of Marble powder in SCC decreases both T50 test time and V –funnel time.
- Increase of Marble Powder in SCC increase passing ability.
- In Hardened property such as Compressive strength, Flexural strength and Split tensile strength would be taken into account , Marble powder can be use up to 10% and Fly ash 25%.
- The positive effect of marble powder 10% and Fly ash 25% by substitute cement in binder material in self-compacting concrete.

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