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USE OF FLY ASH AND CRUSHED SAND FOR MIX PROPORTIONING OF SELF COMPACTING CONCRETE

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Abstract: Self Compacting Concrete (SCC) is focused on achieving concrete with desired properties without applying external compacting effort. Such a concrete is homogeneous, consistent and capable to flow and occupy all the corners of structural element under its own weight. This paper deals with the study of the suitability of crushed sand for producing self compacting concrete and to develop a procedure for mix proportioning of SCC with crushed sand as fine aggregate. To find the optimum fine aggregate content for various water/powder ratios. To establish the relation between water/powder ratio and the compressive strength. and study of effect of superplastisizer, VMA ,and fly ash, on concrete By adopting the different tests Slump- flow , J ring, V funnel, L box, U box, compressive strength, To set the simple design mix procedure for SCC with crushed sand and fly ash. Due to use of admixture improves bonding between aggregates and powder content, which results increasing compressive strength of concrete Hence we find, a] the optimum percentage of fly ash for slump flow and strength b] establish the relation between compressive strength and water/powder ratio c] establish the relation between optimum percentage of fine aggregate for slump flow and water/powder ratio and d] establish the mix design procedure for SCC with crushed sand. For workability, the slump flow was considered as the primary parameter. The optimum percentage of fine aggregate for required minimum slump flow was determined for each water/powder ratio.

Keywords- Self compacting concrete(S.C.C.), Crushed Sand (Artificial Sand), Flyash, Superplastisizer/ V.M.A..

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INTRODUCTION

The necessity of this type of concrete was proposed by Prof. Okamura in 1986. The prototype of SCC was first developed in Japan in 1988 using actual materials available in the market. The European countries later recognized the significance and potentials of SCC. In 1989, The European federation of natural trade associations representing producers and applicators of specialist building products [EFNARC] was established. EFNARC making use of broad practical experience of all members of the federation has drawn up the specifications and guidelines to provide a framework for design and use of high quality self compacting concrete, in 2001.

For self compacting concrete, the same materials which are used for concrete are used i.e cement, coarse aggregate, fine aggregate and water. In addition to these to increase the workability, homogeneity and durability some filler materials are used. These filler materials may be inert or pozzolanic. SCC usually requires a relatively larger quantity of powder in it in the range of 450 to 600 kg/m^3. The use of Self-Compacting Concrete (SCC) due to advantages relating to better working environment (noise and vibration), higher productivity (faster casting), and better quality (fewer mistakes caused by wrongful vibration)

SCC is high performance concrete having very high workability in fresh state. Such a concrete is homogeneous, consistent and capable to flow and occupy all the corners of structural element under its own weight in conjusted reinforcement or space, without applying external force. Means a concrete that is able to flow and fill every part and corner of the formwork, even in the presence of dense reinforcement, purely by means of its own weight and without the need for any vibration or other type of compaction

II. LABORATORY WORK.

Pic 1:-manufacturing S.C.C. with required ingredients.

Pic 2:- Test for slump flow satisfies filling ability of S.C.C.

Pic 3:-Test for U box satisfies passing ability requirements of S.C.C., **Pic 4:- Test for J ring satisfies passing ability requirements of S.C.C.**

Pic 5:-Test for V funnel at T5 minutes satisfies Segregation resistance of S.C.C.

PROPERTIES OF S.C.C. IN FRESH STATE.

Workability of SCC can be characterized by three parameters:

Filling ability - The ability of the fresh concrete to flow under gravitation, or under pressure (e.g. pumping) and totally fill formwork and enclose reinforcement.

• Passing ability - The ability of the fresh concrete to pass confined section of the formwork, dense reinforcement, etc., without the aggregate blocking.

• Resistance to segregation - The ability of the fresh concrete to retain its homogeneity during the casting process and when the concrete has come to rest.

III. CONCRETE MIX DESIGN

DESIGN STIPULATIONS

Grade designation	: M50
Type of cement	: O.P.C. 53 Grade.
Maximum size of Aggregate (MAS)	: 20 mm.
Degree of Supervision	: Good.

Test data for materials	
Sp. Gravity of cement.	:3.15
Sp. Gravity of water.	:1.00
Chemical admixture	:Superplastisizer and V.M.A.
Sp. Gravity of 10 mm aggregate.	:2.77
Sp. Gravity of 20 mm aggregate.	:2.97
Sp. Gravity of sand.	:2.61
Sieve analysis of individual course aggregate.	Separate analysis is done
Sieve analysis of individual fine aggregate.	Separate analysis is done

MIX PROPORTIONS OF QUANTITIES OF MATERIALS, CORRESPONDING SLUMP FLOW VALUES AND STRENGTHS FOR DECIDING OPTIMUM PERCENTAGE OF FLY ASH FOR VARIOUS GRADES OF CONCRETE.

Sr. No.	% of fly ash	Cement Kg	Fly ash ~~Kg~~	C A in kg 10mm	C A in kg 20mm	F A In Kg	Slump flow in mm	7 Days Strength in ~~MPa~~	28 Days strength in ~~MPa~~
1	2	3	4	5	6	7	8	9	10
1	00	520	00	404	359	1057	500	40.66	55.33
2	10	468	52	400	354	1044	550	35.30	67.00
3	15	438	83	395	350	1040	580	35.10	60.00
4	20	416	104	394	350	1031	610	35.00	51.00
5	30	364	156	389	345	1017	650	32.77	42.66
6	34	330	170	395	350	1000	650	27.00	39.00
7	35	338	182	387	343	1011	650	26.00	52.00
8	40	312	208	384	341	1004	700	21.77	36.00
9	50	260	260	380	336	991	630	15.00	34.67

TEST RESULTS FOR FRESH S.C.C. CONCRETE

EFNARC Acceptance Criteria for Self Compacting Concrete

Sr.No	Method	Unit	Typical range of values		Observed value
			Minimum	Maximum	
1	2	3	4	5	6
1	Slump Flow by Abrams cone	mm	650	800	650
2	T 500 slump flow	Sec	2	5	5
3	J ring	mm	0	10	10
4	V funnel	Sec	6	12	11
6	L box	H_2/H_1	0.80	1.0	0.90
7	U box	$[h_2-h_1]$mm	0	30	27

TEST RESULTS FOR FLY ASH WITH CEMENT.

Strength Test: The average strength development as a percentage of OPC strength, using a blend of 25% Pozzocrete with 75% OPC are given in Table

Results of Percentage Strength Development of Fly Ash

Sr. No.	Age in days	Percentage strength	Required percentage strength	Remarks
1	2	3	4	5
1	3	83.22	80 %	Conforming
2	7	93.68	92 %	To
3	28	98.00	97 %	BIS 3812-1981

The actual strength is more than that required by BIS.

PERFORMANCE OF S.C.C. WITH CRUSHED SAND AND FLY ASH

• SCC using crushed sand satisfied the requirements in fresh condition as well as in hardened condition.

• The processed fly ash can be used as filler material to replace cement partially.

• For SCC, use of superplasticiser and viscosity modifying agents achieve required properties in fresh state

• SCC up to M50 grade can be designed with this method.

CONCLUSIONS

From the results of preliminary and main investigations discussed in the previous chapter, following conclusions are drawn.

1. SCC using crushed sand satisfied the requirements in fresh condition as well as in hardened condition. From this, it can be concluded that, crushed sand can be used efficiently for producing SCC.

2. The processed fly ash can be used as filler material to replace cement partially. The slump flow value increased as the fly ash content is increased in SCC. But the compressive strength decreases if the percentage of fly ash is more. Hence, from both the considerations, it is concluded that fly ash can be used up to 35 % of total cementitious material.

3. For SCC, use of superplasticiser and viscosity modifying agents are essential. It is necessary to find the optimum percentage of superplasticiser and viscosity modifying agent. In the present investigation, 0.60 % superplasticiser and 0.10% viscosity modifying agent is added to achieve required properties in fresh state.

4. From investigations water/ powder ratio versus strength, it is concluded that as the water/ powder ratio increases the compressive strength decreases. For producing concretes up to grades M50, W/P ratio should be in between 0.30 to 0.45.

5. The optimum percentage of fine aggregate increases with increase in W/P ratio. The optimum percentage of FA is in between 0.50 to 0.60 of total mass of aggregate.

6. SCC up to M50 grade can be designed with this method.

7. Even though the observed compressive strengths are less than the target strengths, these are satisfying the grades of concrete.

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