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"EFFECT OF RECYCLED AGGREGATES ON PROPERTIES OF SELF COMPACTING CONCRETE CONTAINING CLASS-F FLY ASH AND GLASS WASTE"

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Abstract-The self-compacting mixtures will have cement replacement of 30% Class-F fly ash with 20% glass waste, 40% Class-F fly ash with 10% glass waste, and 50% Class-F fly ash without any addition of glass waste . Natural coarse aggregates content 0%, 20%, 40%, 60%, 80%, 100% will be replaced by recycled aggregates. Tests are to be carried out on all mixtures to obtain the properties of fresh concrete in terms of viscosity and stability. In the experimental work, the fresh properties of SCC such as, (Slump flow and V-funnel) and the hardened properties, (compressive strength) will be found out.

Keywords- SCC- Self Compacted Concrete ,RAC- Recycled Aggregate Concrete, NAC-Natural Aggregate Concrete, GW- Glass waste, CA- Course Aggregate , FA- Fine Aggregate

I. INTRODUCTION

Self-compacting concrete is a type of concrete that gets compacted under its self-weight. It is commonly abbreviated as SCC and defined as the concrete which can be placed and compacted in to every corner of a formwork, purely by means of its self-weight and eliminating the need of either external energy input from vibrators or any type of compacting efforts. It is also referred as self-leveling concrete, super workable concrete, highly-flowable concrete, non-vibrating concrete etc.

One of the obvious limitations of producing SCC is the higher material costs not only for the chemical admixture, but also for the increased quality control testing needed for concrete and aggregates.

RA created mainly from crushing old concrete masses, the type of RA that contains little or no impurities and produced in a recycling plant; and from now on RA would mean aggregate in this category. However, there are also some restrictions on this type of aggregate: many standards, guidelines and codes worldwide specify 20% RA replacement for NA in concrete

Waste glass,quarry waste fines,various ashes and dredging silts may also be suitable for use as fillers and fine aggregates,and some(such as glass sand) may again improve rheological properties.

II. EXPERIMENT METHODOLOGY

2. TEST ON FRESH CONCRETE

2.1. Slump Flow Test:

About 6 liter of concrete is needed to perform the test, sampled normally. Moisten the base plate and inside of slump cone. Place base plate on level stable ground and the slump cone centrally on the base plate and hold down firmly. Fill the cone with the scoop. Do not tamp, simply strike off the concrete level with the top of the cone with trowel. Remove any surplus concrete from around the base of the cone. Raise the cone vertically and allow the concrete to flow out freely. Simultaneously, start the stopwatch and record the time taken for the concrete to reach the 500mm spread circle. (This is T50 time). Measure the final diameter of the concrete in two perpendicular directions. Calculate the average of the two measured diameters. (This is slump flow in mm)

2.2.V-Funnel Test And V-Funnel Test At T5 Minutes

2.1.1. Assessment of test

Though the test is designed to measure flow ability, the result is affected by concrete properties other than flow. The inverted cone shape will cause any liability of the concrete to block to be reflected in the result – if, for example there is too much coarse aggregate. High flow time can also be associated with low deformability due to high paste viscosity, and with high inter-particle friction. While the apparatus is simple, the effect of the angle of the funnel and the wall effect on the flow of concrete are not clear.

2.2.2. Procedure flow time:

About 12 liter of concrete is needed to perform the test, sampled normally. Set the V-funnel on firm ground. Moisten the inside surfaces of the funnel. Keep the trap door open to allow any surplus water to drain. Close the trap door and place a bucket underneath. Fill the apparatus completely with concrete without compacting or tamping simply strike off the concrete level with the top with the trowel. Open within 10 sec after filling the trap door and allow the concrete to flow out under gravity. Start the stopwatch when the trap door is opened, and record the time for the discharge to complete (the flow time). This is taken to be when light is seen from above through the funnel. The whole test has to be performed within 5 minutes

3.2.4.5 Procedure flow time at T5 minutes:

Do not clean or moisten the inside surfaces of the funnel again. Close the trap door and refill the v-funnel immediately after measuring the flow time. Place a bucket underneath. Fill the apparatus completely with concrete without compacting or tapping, simply strike off the concrete level with the top with the trowel. Open the trap door 5 minutes after the second fill of the funnel and allow the concrete to flow out under gravity. Simultaneously start the stopwatch when the trap door is opened, and record the time for the discharge to complete (the flow time T 5minutes). This is taken to be when light is seen from above through the funnel.

3. TEST ON HERDNED CONCRETE

3.1. Compression Test

The compression test is carried out on specimens cubical or cylindrical in shape. Prism is also sometimes used, but it is not common in our country. Sometimes, the compression strength of concrete is determined using parts of a beam tested in flexure. The end parts of beam are left intact after failure in flexure and, because the beam is usually of square cross section, this part of the beam could be used to find out the compressive strength. The cube specimen is of the size 15 x 15 x 15 cm. If the largest nominal size of the aggregate does not exceed 20 mm, 10 cm size cubes may also be used as an alternative. Cylindrical test specimens have a length equal to twice the diameter. They are 15 cm in diameter and 30 cm long. Smaller test specimens may be used but a ratio of the diameter of the specimen to maximum size of aggregate, not less than 3 to 1 is maintained.

III. MIX DESIGN AND TESTING

Constitute detail			M20					
			50% fly ash					
			0% R.A.	20% R.A.	40% R.A.	60% R.A.	80% R.A.	100% R.A.
Cement		Kg/m3	207					
Fly Ash		Kg/m3	207					
Glass waste powder		Kg/m3	0					
Sand		Kg/m3	855					
Coarse Aggregate	20 mm	Kg/m3	511	408.8	306.6	204.4	102.2	0
	10 mm	Kg/m3	342	273.6	205.2	136.8	68.4	0
Recycled Aggregate	20 mm	Kg/m3	0	102.2	204.4	306.6	408.8	511
	10mm	Kg/m3	0	68.4	136.8	205.2	273.6	342
Admixture (SP)		Litre / m^3	4.14					
Water		m^3	0.188					
		Litre	188					
W/P ratio		-	0.45					
VMA		Litre / m^3	0.414					

Constitute detail			M20					
			40% fly ash					
			0% R.A.	20% R.A.	40% R.A.	60% R.A.	80% R.A.	100% R.A.
Cement		Kg/m3	249					
Fly Ash		Kg/m3	165					
Glass waste powder		Kg/m3	86					
Sand		Kg/m3	774					
Coarse Aggregate	20 mm	Kg/m3	514	411.2	308.4	205.6	102.8	0
	10 mm	Kg/m3	342	273.6	205.2	136.8	68.4	0
Recycled Aggregate	20 mm	Kg/m3	0	102.8	205.6	308.4	411.2	514
	10mm	Kg/m3	0	68.4	136.8	205.2	273.6	342
Admixture (SP)		Litre / m^3	4.14					
Water		m^3	0.188					
		Litre	188					
W/P ratio		-	0.45					
VMA		Litre / m^3	0.414					

Constitute detail			M20					
			30% fly ash					
			0% R.A.	20% R.A.	40% R.A.	60% R.A.	80% R.A.	100% R.A.
Cement		Kg/m3	290					
Fly Ash		Kg/m3	124					
Glass waste powder		Kg/m3	173.6					
Sand		Kg/m3	694.4					
Coarse Aggregate	20 mm	Kg/m3	516	412.8	309.6	206.4	103.2	0
	10 mm	Kg/m3	344	275.2	206.4	137.6	68.8	0
Recycled Aggregate	20 mm	Kg/m3	0	103.2	206.4	309.6	412.8	516
	10mm	Kg/m3	0	68.8	137.6	206.4	275.2	344
Admixture (SP)		Litre / m^3	4.14					
Water		m^3	0.188					
		Litre	188					
W/P ratio		-	0.45					
VMA		Litre / m^3	0.414					

IV. RESULTS AND CONCLUSIONS

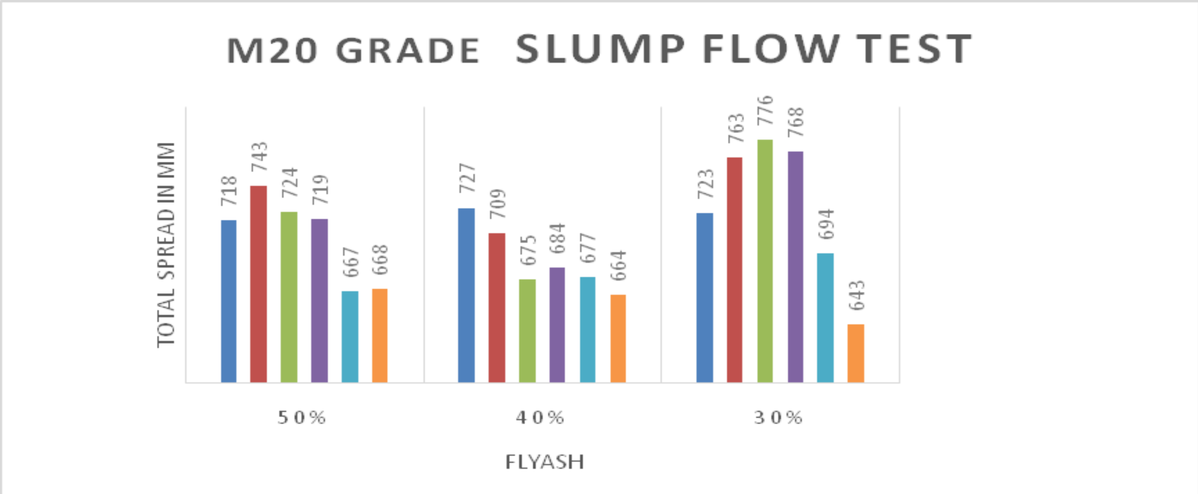

Fig 6.2 Slump Flow Test for M20 Grade Concrete for 50%, 40% and 30% Fly Ash and 0%,10% and 20% g.w

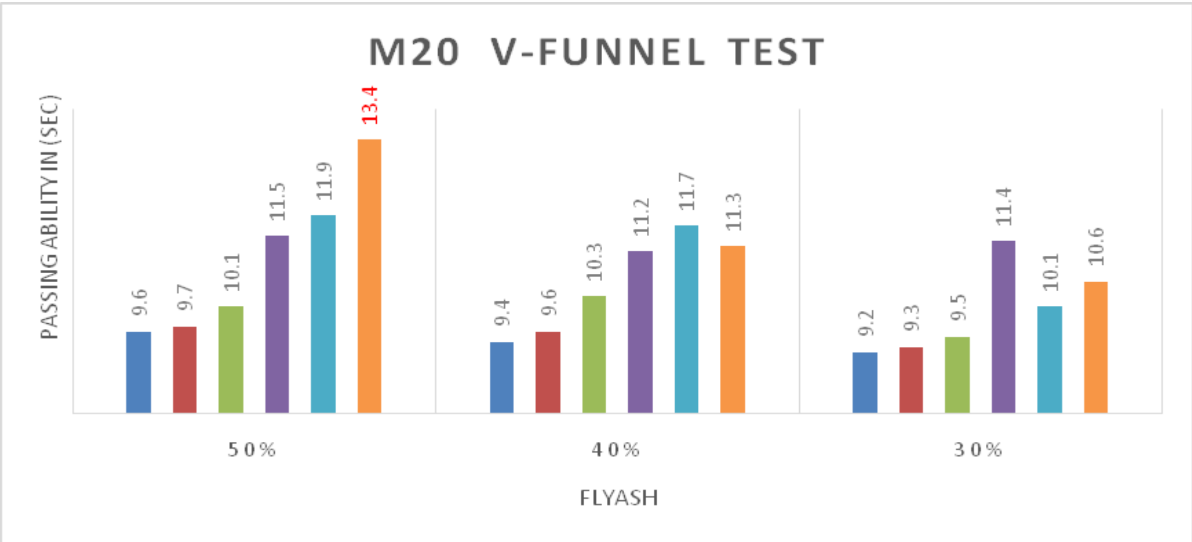

Fig-6.4 V-Funnel Test for M20 Grade Concrete for 50%, 40% and 30% Fly Ash and 0%,10% and 20% g.w

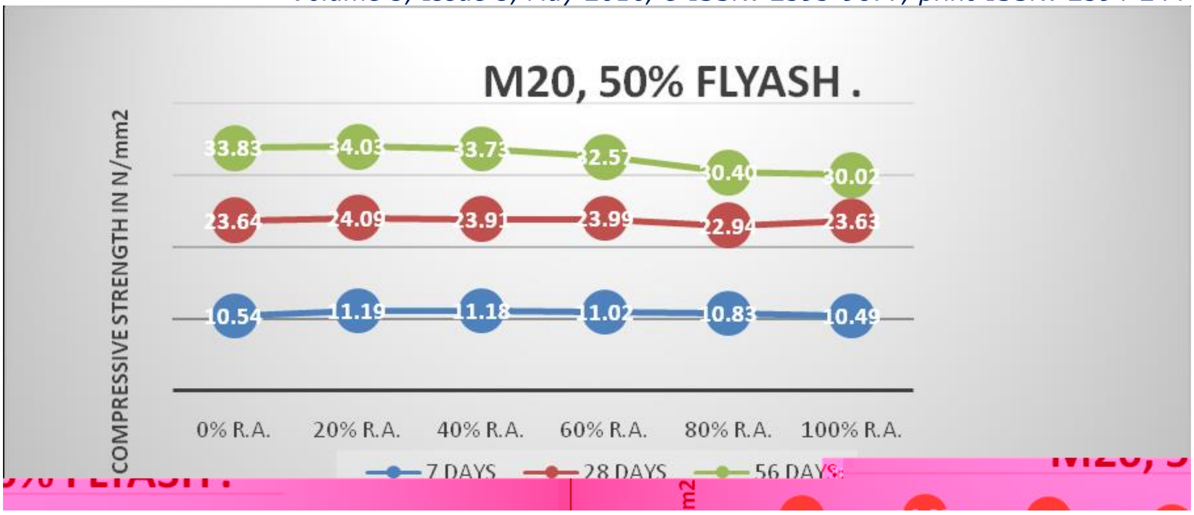

Fig-6.6 M20 Comp. Str. for 50% Fly Ash without glass waste Variation in R.A. Content

Fig 6.7 M20 Comp. Str. for 40% Fly Ash and 10% glass waste of Variation in R.A. Content

Fig 6.8 M20 Comp. Str. for 30% Fly Ash and 20% glass waste of Variation in R.A. Content

Now observed from the above figs we conclude that if we increase the Fly Ash content than there is a decrease in compressive strength of self compacting recycled aggregate concrete.

When the test was carried out for 28 days using M20 grade mix proportion with 50%, 40% and 30% content of fly ash with different R.A. content and addition of glass waste powder.

- As per **IS: 10262-2009** the target mean compressive strength at 28 days should be 26.6 N/mm^2. But for M20 grade of concrete compressive strength at 28 days should be at least 20 N/mm^2 for any content of fly ash and glass waste.
- The test was carried out for 50% fly ash without addition of glass waste, the comparative result of this fly ash were for 0% , 20%, 40%, 60%, 80% and 100% R.A., 24.12, 24.09, 24.07,23.99, 22.94, and 23.63 N/mm2 respectively.
- The test was carried out for 40% fly ash and 10% glass waste, the comparative result for 0% , 20%, 40%, 60%, 100% and 50% R.A., 26.92, 26.20, 25.74, 24.10, 22.61 and 22.49 N/mm2 respectively.
- The test was carried out for 30% fly ash and 20% glass waste, the comparative result for 0% , 20%, 40%, 60%, 80% and 100% R.A., 27.20, 26.81, 26.61, 25.84, 25.42 and 24.13 N/mm2 respectively

V. FUTURE SCOPE OF WORK

- In this dissertation work only fly ash and glass waste powder was used to improve rheological properties.Other pozzolanic material like blast furnace slag and silica fume can also advantageously used.
- Structural/non structural fiber can also be used in SCC mix with recycled aggregate concrete application
- The properties studied in this project were workability tests, compressive strength. Other properties such as flexural strength abrasion resistance, impact resistance (toughness), Durability, etc can be studied in detail.

Alternate admixture chemicals should be studied to ensure that the performance gained for the tested mix is also achievable if other brands are used.

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