International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 04 Issue: 09 | Sep -2017 www.irjet.net p-ISSN: 2395-0072

Experimental Investigation on Self Compacting Concrete with Replacement of Natural Sand by Robosand and Coarse Aggregate by Cinder for M30 Grade Concrete

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Abstract: In recent years Self compacting concrete has gained wide use for placement in congested reinforced concrete for such application the fresh concrete must possess high fluidity and good cohesiveness. In the present study the effect of replacing the natural sand by robosand for 25%,30% keeping these percentages as constant and replacing the coarse aggregate by cinder in varing percentages of 0%, 10%, 20%, 30%,40% and 50% respectively. The M30 grade concrete is taken up to study the strength characteristics of self compacting concrete.

In this study the fresh property and hardened property of concrete were determined, the fresh concrete property shows good flow and hardened concrete the compressive strength results 21% higher than Normal self compacting concrete with replacement of 25% natural sand by robo sand and 40% of coarse aggregate by cinder, Split tensile strength results 21.5% more than the Normal self compacting concrete with replacement of 30% natural sand by robo sand and 40% of coarse aggregate by cinder, flexural strength results 23% higher than Normal self compacting concrete with replacement of 30% natural sand by robo sand and 50 % of coarse aggregate by cinder.

Key Words: **Robosand, Cinder, Normal Self Compacting Concrete (NSCC).**

I. INTRODUCTION

Self-compacting concrete (SCC) is an innovative concrete which is exceedingly flow-able and non segregating concrete. SCC does not require any external compaction and which flows under its own weight even in dense reinforcement. SCC ensures filling ability, passing ability and segregation resistance of fresh concrete. In SCC some of mineral admixtures are added with cement as filler material which increases volume of paste content to achieve good fluidity and durable concrete. In SCC amount of water content is reduced by using some of water reducing super plasticizers to retain segregation resistance and durable concrete.

Fly ash is a byproduct of coal obtained from thermal power plants. During coal combustion process carbon materials are burnt off from coal only some of mineral impurities of shale, clay are remained and these minerals are brought out from combustion unit and allowed to solidify and these solid spherical particles called as fly ash. Many investigations are carried out to utilize flyash as cement replacement, by replacing cement with flyash, which avoids environmental, disposal problems and also makes the concrete economical. Self-compacting concrete has more fluidity to achieve these properties need to increase the volume of paste content, so that fly ash is added to the cement as filler material which increases the flow-ability of concrete.

Artificial sand is popularly known by several names such as crushed sand, Rock sand, Green sand, Robosand, Pozzolana sand etc. the crusher dust which is also known as Robosand can be used as an alternative material for the river sand. Robosand possess similar properties as that of river sand and hence accepted as a building material Robosand or M-Sand was used as replacement of fine aggregate. Robosand is a product of crushed stone, here the stones are crushed into smaller granular size of river sand granules and washed to remove the fine rock dust to enhance the quality. Cinder is a naturally occurring light weight rock of igneous origin. It is a pyroclastic material which is similar to that of pumice and has many cavities with low density which can float in water. Cinder is the material comes under the category light weight aggregate and it is a byproduct of steel iron manufacturing companies. The surface of cinder aggregate is usually rough and highly porous due to mineral structure. The cinder material visually classified as having 100% crushed face.

II. OBJECTIVES

a. The main objective of this is investigation of Self compacting concrete to determine the suitable percentage of Robosand and cinder replacement.
b. To study the fresh concrete properties and hardened properties of concrete.
c. To study percentage replacement of natural sand by Robosand and coarse aggregate by cinder for M30 grade of concrete.
d. It is intended to compare the properties of concrete in fresh and hardened state by keeping replacement of natural sand by Robosand at 25% and 30% and Varying

with coarse aggregate by cinder in different percentages such as 0%, 10%, 20%, 30%, 40%, & 50%.

III. EXPERIMENTAL PROGRAM

In this investigation78–cubes,78-cylinder78,-prism are tested to investigate Compressive strength, Split tensile Strength and flexural Strength of SCC. All test specimens of Cubes with 150X150X150 mm, Cylinders of 150mm diameter and 300mm length and Prism of 500mmX100mmX100mm.

Materials used in these experiments.

1) **Cement:**

Ordinary Portland cement of 53 grade is used in the present investigation. The physical and mechanical properties of the cement used are shown in the Table1.

Table-1 properties of cement

SL No	Properties	Results
1	Fineness	3%
2	Specific gravity	3.08
3	Normal consistency	32%
4	Initial setting time	120 mins
5	Final setting time	225 mins

2) **Fly-ash:**

Flyash is used in the present investigation collected from Raichur thermal power plant. The physical properties and chemical properties (from internet) of the flyash used are shown in the Table 2.

Table-2 Properties of Flyash

SL No	Properties	Results
1	Specific gravity	2.09

Chemical Properties of Flyash

Constituents	Fly ash (%)
SiO_2	60.98
Al_2O_3	27.5
TiO_2	1.27
Fe_2O_3	4.1
MgO	0.78
CaO	1.65
K_2O	0.15
Na_2O	0.17
LOI	5.35

3) Fine aggregates:

River sand passing 4.75mm I.S sieve is used as fine aggregates, according to IS 383-1970 fine aggregates falls under zone II. Properties of fine aggregate as shown in table 3.

Table-3 Properties of fine aggregates

Physical Properties of fine aggregates			
SL No	Properties	Natural sand	Robosand
1	Specific gravity	2.61	2.97
2	Bulk density	1540 kg/m^3	3210 kg/m^3
3	Fineness modulus	3.2	3.72

4) Coarse aggregates:

Angular shaped 12.5mm down size aggregates is used as coarse aggregates collected from stone quarries. Physical Properties of Coarse aggregate and cinder is shown in table 4.

Table-4 Physical Properties

Physical Properties of coarse aggregates			
SLNo	Properties	Natural Coarse aggregate	Cinder
1	Specific gravity	2.85	2.08
2	Bulk density	1560 kg/m^3	1050 kg/m^3
3	Fineness modulus	5.6	2.81

5) Super plasticizer:

Master Galenium sky is used as super plasticizer in the present investigation. It reduces water demand and provides better workability properties of SCC without any segregation. It is free from chloride and low alkali in nature. Dosages of plasticizer evaluated by trail mixes.

6) Water:

Ordinary portable water is used.

Table-5 Mix Proportions

MIX	Quantities of materials in Kg/m³					
	Cementatious Contents		Fine aggregates		Coarse aggregates	
	Cement	Fly ash	RoboSand	Natural Sand	Cinder	Natural Aggregate
NSCC	385	124	0	848	0	752
0 % cinder	385	124	212	636	0	752
10% cinder	385	124	212	636	75	677
20% cinder	385	124	212	636	150	602
30% cinder	385	124	212	636	225	526
40% cinder	385	124	212	636	301	451
50% cinder	385	124	212	636	376	376
0 % cinder	385	124	254	594	0	752
10 % cinder	385	124	254	594	75	677
20 % cinder	385	124	254	594	150	602
30 % cinder	385	124	254	594	225	526
40 % cinder	385	124	254	594	301	451
50 % cinder	385	124	254	594	376	376

IV. RESULT AND DISCUSSIONS

This chapter consists of results and discussions on workability, compressive strength, split tensile strength and Flexural strength of Self compacting concrete compared with Normal Self compacting Concrete (NSCC).

A) Properties of Fresh SCC :

The workability is measured by flow properties as per EFNARC. The values of flow properties with constant water/cement ratio for Self compacting concrete for different mixes were measured.

Table-6 Workability test results

Parameters	Percentage replacement of coarse aggregate by cinder (%)	Percentage of Super plasticizer	SCC slump flow (mm)		T_{50} Slump flow (sec)	V funnel (sec)	L-Box (h_2/h_1)
			Min	650	2	6	0.8
			Max	800	5	12	1
NSCC		0	453		6.35	20	1.89
25% Replacement of natural sand by Robosand	0 cinder	0.4	685		4	7	0.95
	10 cinder	0.4	680		4.5	7.5	0.91
	20 cinder	0.5	677		4	8.6	0.86
	30 cinder	0.5	672		3.5	9.2	0.84
	40 cinder	0.6	670		4.5	10.1	0.85
	50 cinder	0.7	658		4.8	11	0.82
30% Replacement of natural sand by Robosand	0 cinder	0.3	665		4.2	7.5	0.92
	10 cinder	0.3	670		4.35	7.9	0.89
	20 cinder	0.4	670		4.4	8.9	0.86
	30 cinder	0.4	670		3.86	9.5	0.88
	40 cinder	0.5	685		4.61	10.6	0.85
	50 cinder	0.6	700		4.9	11.5	0.83

B) Properties of hardened SCC

The properties of hardened SCC were measured in terms of Compressive Strength confirming to IS 516-1959 for curing periods of 7 &28 days.

Tensile strength of concrete is obtained indirectly by subjecting concrete cylinders to the action of compressive force along two opposite generators of a concrete cylinder placed with its axis horizontal between the compressive platens. The split tensile test is carried out as per IS: 5816-1970.The magnitude of tensile stress was evaluated using the relation σSP = 2P/ πDL for curing periods of 7 &28 days. The Flexural strength of concrete is obtained by placing the specimen in the machine in such a manner that the load, shall be applied to the uppermost Surface as cast in the mould, along two roller points spaced 20·0 or 13·3 cm apart. The axis of the specimen shall be carefully aligned with the axis of the loading device. The load shall be increased until the specimen fails, and the maximum load applied to the specimen during the test shall be recorded. The appearance of the fractured faces of concrete and any unusual features in the type of failure shall be noted. The flexural strength of the specimen shall be expressed as Flexural strength = PL/bd2 for curing periods of 7 &28 days

Table-7 Compressive strength

Parameters	Percentage replacement of coarse aggregate by cinder (%)	Compressive strength (N/mm²)	
		7 days	28 days
NSSC		22.35	30.25
25% Replacement of natural sand by Robosand	0 cinder	24.56	30.64
	10 cinder	24.98	31.73
	20 cinder	23.65	33.15
	30 cinder	24.34	34.21
	40 cinder	26.87	36.84
	50 cinder	24.96	35.13
30% Replacement of natural sand by Robosand	0 cinder	23.15	33.21
	10 cinder	22.98	33.98
	20 cinder	24.15	34.65
	30 cinder	24.89	36.15
	40 cinder	22.56	34.12
	50 cinder	21.67	35.15

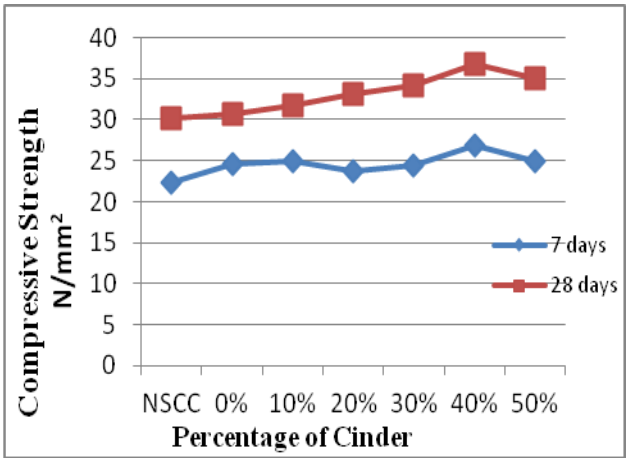

Fig 1: compressive strength for 25% Replacement of natural sand by Robosand along with varying percentages of coarse aggregate by cinder at 7days and 28 days.

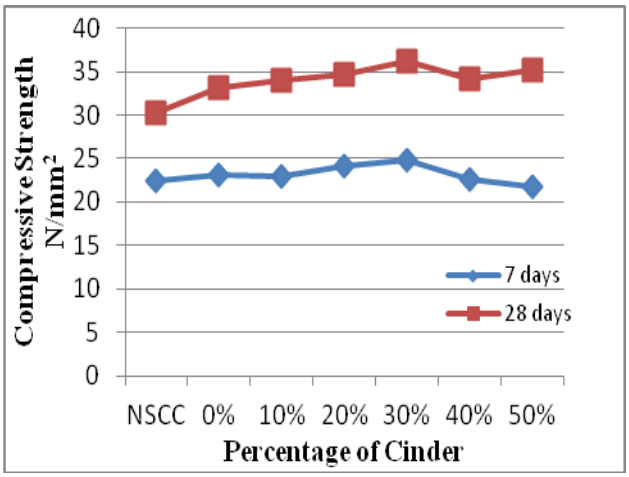

Fig 2: compressive strength for 30% Replacement of natural sand by Robosand along with varying percentages of coarse aggregate by cinder at 7 days and 28 days.

It is observed that for 25% replacement of natural sand by Robo sand along with replacement of coarse aggregate at 0%, 10%,20%,30%,40%,& 50% by cinder is shown in figure 1. Result show that 40% replacement of coarse aggregate by cinder obtained maximum compressive strength of 36.84 (N/mm²) for 28 days curing, which is more than Normal self compacting concrete.

Similarly 30% replacement of natural sand by Robosand and with replacement of coarse aggregate at 0%, 10%, 20%, 30%, 40%, & 50%. by cinder is shown in figure 2. Result show that 30% replacement of coarse aggregate by cinder will give maximum compressive strength of 36.15 (N/mm²) at 28 days curing, which is more than Normal self compacting concrete.

Table-8 Split tensile strength

Parameters	Percentage replacement of coarse aggregate by cinder (%)	split tensile strength (N/mm²)	
		7 days	28 days
NSSC		2.09	3.25
25% Replacement of natural sand by Robosand	0 cinder	2.16	3.12
	10 cinder	2.26	3.38
	20 cinder	2.45	3.53
	30 cinder	2.5	3.61
	40 cinder	2.53	3.86
	50 cinder	2.48	3.58
30% Replacement of natural sand by Robosand	0 cinder	2.34	3.35
	10 cinder	2.18	3.26
	20 cinder	2.3	3.31
	30 cinder	2.45	3.78
	40 cinder	2.52	3.95
	50 cinder	2.38	3.51

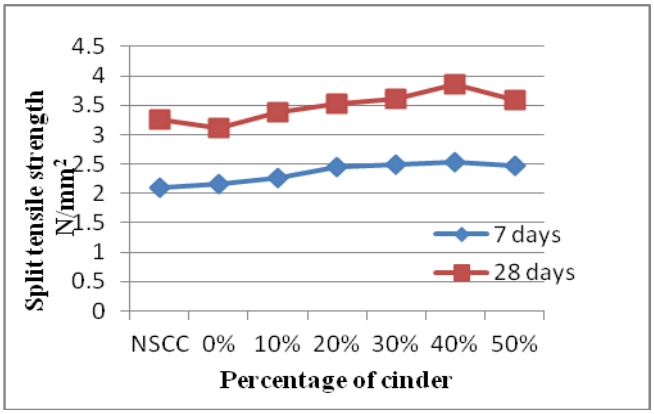

Fig 3: Split tensile strength for 25% Replacement of natural sand by Robosand along with varying percentages of coarse aggregate by cinder at 7 days and 28 days.

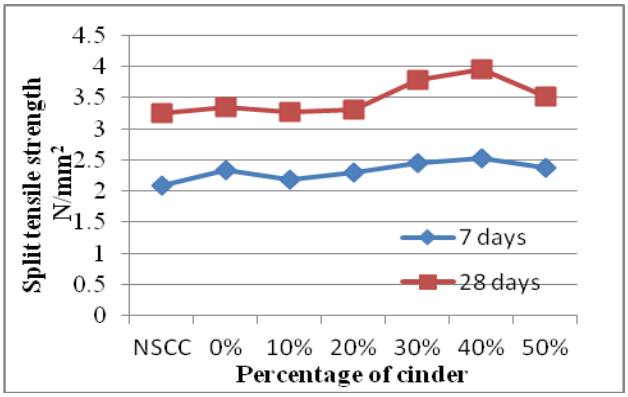

Fig 4: Split tensile strength for 30% Replacement of natural sand by Robosand along with varying percentages of coarse aggregate by cinder at 7 days and 28 days.

Figure 3 & 4 shows the 25% & 30% replacement of natural sand by Robo sand and with replacement levels of coarse aggregate at 0%, 10%, 20%, 30%, 40% & 50% by cinder. Result show that 40% replacement of coarse aggregate by cinder will show maximum split tensile strength of 3.95 (N/mm²) for 28 days curing, which is more than Normal self compacting concrete

Table 9: Flexural strength

Parameters	Percentage replacement of coarse aggregate by cinder (%)	Flexural Strength (N/mm²)	
		7 days	28 days
NSSC		2.2	3.21
25% Replacement of natural sand by Robosand	0 cinder	2.25	3.17
	10 cinder	2.28	3.2
	20 cinder	2.37	3.28
	30 cinder	2.65	3.36
	40 cinder	2.86	3.53
	50 cinder	2.83	3.45
30% Replacement of natural sand by Robosand	0 cinder	2.95	3.26
	10 cinder	2.98	3.53
	20 cinder	2.65	3.37
	30 cinder	2.73	3.58
	40 cinder	2.86	3.78
	50 cinder	2.75	3.95

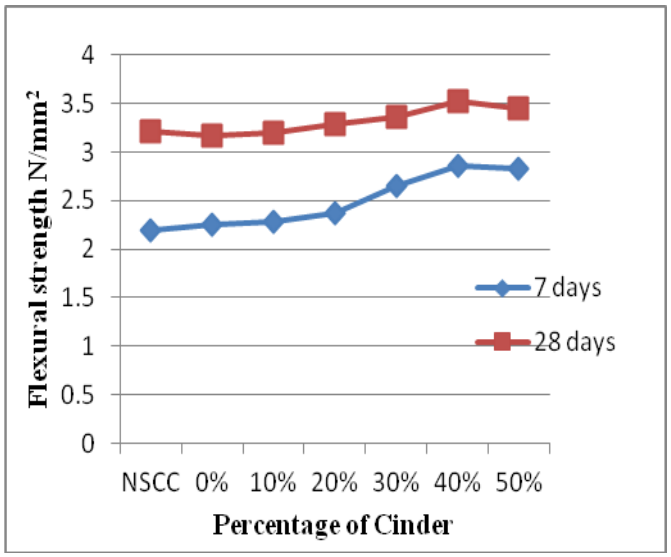

Fig 5: Flexural strength for 25% Replacement of natural sand by Robosand along with varying percentages of coarse aggregate by cinder at 7 days and 28 days.

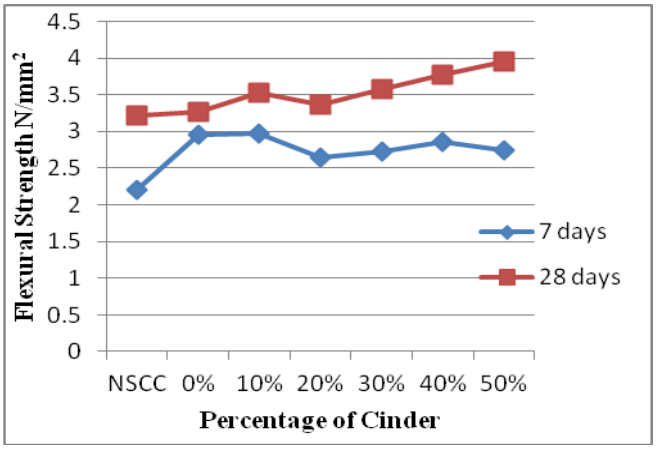

Fig 6: Flexural strength for 30% Replacement of natural sand by Robosand along with varying percentages of coarse aggregate by cinder at 7 days and 28 days.

It is observed that 25% replacement of natural sand by Robo sand and with replacement levels of coarse aggregate at 0%,10%,20%,30%,40%,& 50% by cinder is shown in figure 5. Result show that 40% replacement of coarse aggregate by cinder will give maximum flexural strength of 3.53(N/mm²) at 28 days of curing, which is more than Normal self compacting concrete. Similarly 30% replacement of natural sand by Robo sand and with replacement levels of coarse aggregate at 0%, 10%, 20%, 30%, 40%,& 50% by cinder is shown in figure 6. Result show that 50% replacement of coarse aggregate by cinder will give maximum flexural strength of 3.95 (N/mm²) at 28 days of curing which is more than Normal self compacting concrete.

V CONCLUSIONS

i. As the percentage of increase in replacement levels of 0%, 10%, 20%,30%,40%,&50% Coarse aggregate by cinder with constant 25% replacement of natural sand by Robosand. it is observed that there is decrease in workability.
ii. As the percentage of increase in replacement levels of 0%, 10%, 20%, 30%,40%,&50% Coarse aggregate by cinder with constant 30% replacement of natural sand by Robosand. it is concludes that there is increase in workability.
iii. Robosand qualifies 40% economic than the natural sand.
iv. The results showed good flow ability and passing ability properties with replacement of natural sand by robosand and coarse aggregate for self compacting concrete.
v. The experimental results the compressive strength of Self compacting concrete with replacement of 25% natural sand by robo sand and 40% of coarse aggregate by cinder indicates an increase of 21% in comparison with Normal self compacting concrete.
vi. The Split tensile strength of Self compacting concrete with replacement of 30% natural sand by robo sand and 40% of coarse aggregate by cinder indicates an increase of 21.5% in comparison with Normal self compacting concrete .
vii. The Flexural strength of Self compacting concrete with replacement of 30% natural sand by robo sand and 50% of coarse aggregate by cinder indicates an increase of 23% in comparison with Normal self compacting concrete .
viii. From experimental investigation at 25% replacement of natural sand by robo sand and 40% replacement of coarse aggregate by cinder indicates and increase in 21% compressive strength,18% split tensile strength and 9.9% in flexural strength for 28 days curing in compared with Normal self compacting concrete.

VI REFERENCES

1. Sanjay raj ,Yogananada N "Experimental investigation on Self-Curing Self-Compacting Concrete by Replacing Natural Sand by M-sand and Coarse aggregates By Light Weight Aggregate for M-40 Grade Concrete".

2. Rajkumar R "Performance of self compacting concrete using fly ash and M sand".

3. Rachana M N, E. Ramesh Babu. " Experimental investigation on Robosand as replacement material of fine aggregate in normal concrete".

4. V. Giridhar Kumar "Investigation on properties of Light eight cinder Aggregate concrete"

5. B. Veeresh B. B. C. O. Prasad k. Sateesh Kumar "Light Weight Aggregate Concrete by using Cinder"

6. Dr.P. Sri Chandana, Ph.d "A Study on Properties of Light Weight Cinder Aggregate Concrete with Silica Fume and Fly Ash as Admixtures"

7. "mix design as per nan su method"

8. Benchaa Benabed a, El-Hadj Kadri b, Lakhdar Azzouz a, Said Kenai. "Properties of self-compacting mortar made with various types of sand"

9. M.s. Ravikumar, selvamony c, s.u. kannan and s. basil gnanappa"Behaviour of self compacted self curing kiln ash concrete with various admixtures"

10. Tarun R. Naik , Rakesh Kumar, Bruce W. Ramme, Fethullah Canpolat, "Development of high-strength, economical self-consolidating concrete"