[Satyanarayana , 4(1): January 2017] ISSN 2348 – 8034
DOI- 10.5281/zenodo.263966 Impact Factor- 4.022

GLOBAL JOURNAL OF ENGINEERING SCIENCE AND RESEARCHES

COMPARITIVE STUDY ON STRENGTH OF TERNARY BLENDED FIBER REINFORCED SELF-COMPACTING CONCRETE

D.Satyanarayana[*1], Mohmmed.Shahebaz[2] & A.Jeevan Raju[3]
[*1]Assistant professor, Department of civil engineering , Nalgonda ,India
[2]Assistant professor, Department of civil engineering , Nalgonda ,India
[3]Assistant professor, Department of civil engineering , Nalgonda ,India

ABSTRACT

Generally SCC requires a large content of binder and chemical admixtures compared to ordinary concrete .Sustainable development is mandatory to protect our environment. Rice husk ash which reduces the emission of carbon and produces green effect in environment. In this research the experimental investigations carried out in three phase M30 mix grade concrete is used with FLYASH in proportions of 0%,10%,20%,30%,40%and 50%. In second phase RHA in various proportions of 0%,2%,4%,6%,8%and 10% were tested . In third phase combination of Steel fibers in various proportions of 0%,0.5%,1%,1.5%,2%and 2.5% , rice husk ,Fly ash were tested .From this research the results are much better as compare to conventional concrete.

Keyword: *Rice husk ash (RHA),Fly ash(F), Self compacting concrete(SCC), Steel fibers ,compressive strength, split tensile strength, conventional concrete, workability*

I. INTRODUCTION

Concrete defined as a composite material made up of composed granular material (the aggregate or filler) embedded in a hard matrix of material (cement or binder) and water. Concrete is the age old building material which is abundantly used in construction, and it is most likely that it will continue to have the same influence in future. However, these construction and engineering materials must meet new and higher demands They are many types of concrete with different material used in mix design. Use of cement alone as a binder material produces large heat of hydration. Since the production of this raw material produces lot of CO2 emission. The carbon dioxide emission from the cement raw material is very harmful to the environmental changes. Nowadays many researchers have been carried out to reduce the co2.The effective way of reducing co2 is using rice husk ash which is an agricultural residue accounts for 20%of 649.7 million tons of rice produced annually worldwide. The produced partially burnt husk from the milling plants when used as a fuel also contributes to pollution and efforts are being made to overcome this environmental issue by utilizing this material as a supplementary cementing material. One direction in this evolution is towards self-compaction concrete (SCC) modified product that, without additional compaction energy, flows and consolidation under the influence of its own weight. The use of SCC offers a more industrial production. Compared to normally vibrated concrete, self-compacting concrete possesses enhanced qualities and improves productivity and working conditions due to elimination of compaction. SCC generally has higher powder content than Normally Vibrated Concrete (NVC) and thus it is necessary to replace some of the cement by additions to achieve an economical and durable concrete. The Self Compacting Concrete is a concrete which flows and settles due to its own weight without segregation and bleeding.

II. MATERIALS USED

Cement

The cement used in this experiment was the ordinary Portland cement of 53 grade conforming to IS 12269: 2013 . The cement with the specific gravity 3.14.

Fly Ash

Fly ash is finely divided residue that results from the combustion of coal and transported by flue gas. The colour of fly ash is grey with specific gravity 2.13.

Rice husk
ash Rice husk ash is a pozzolanic material . Rice husk ash is obtained by burning rice husk in a controlled manner without causing environmental pollution. The specific surface of RHA is between 50000-100000 m2/kg.In this investigation specific gravity for RHA is 2.3.

Fine aggregates
The locally available sand is used as fine aggregate in the present investigation. The sand is free from clayey matter, salt and organic impurities. The sand is tested for various properties like specific gravity, sieve analysis, bulk density etc., and in accordance with IS 2386-1963.Its specific gravity was 2.53.

Coarse aggregate
Machine crushed angular granite of 16mm nominal size from the local source is used as coarse aggregate. It is free from impurities such as dust, clay particles and organic matter etc. The physical properties of coarse aggregate were investigated in accordance with IS 2386 -1963. Its specific gravity was 2.59.

Water
Locally available water is used for mixing and curing which is potable and is free from injurious amounts of oils, acids, alkalis, salts, sugar, organic materials or other substances that may be deleterious to concrete or steel.

Fibers
Dramix steel fibers with aspect ratio 80/60 were used. Typical properties of Dramix steel fibers as shown below.

Typical properties of dramix steel fibers

Property	Dramix fiber
Thermal expansion coefficient	12 x 10 -6/°C
Melting point	1500°C
Young's modulus	210000 MPa
Tensile strength	500 – 2000 MPa
Density	7850 kg/m3
Corrosion resistance	in concrete cracks < 0.2 mm
Typical length of fibers	30-60 mm
Typical diameter of fibers	0.5 – 1.0 mm

Steel fibers

III. EXPERIMENTAL INVESTIGATION

In present study M30 grade concrete were designed as per IS: 10262-2009 A.

Workability
Freshly mixed concrete were tested for workability by slump test. In this investigation, M30 mix concrete the test by-weight basis by replacing cement by 0%,10%,20%,30%,40%and 50% with flyash and 0%,2%,4%,6%,8% and

10% with RHA and 0%,0.5%,1%,1.5%and 2% with steel fibers the combine effect of flyash, RHA and steel fibers are carried out.

Compressive strength

In this investigation, M30 mix concrete the test by-weight basis by replacing cement by 0%,10%,20%,30%,40%and 50% with flyash and 0%,2%,4%,6%,8% and 10% with RHA and 0%,0.5%,1%,1.5%and 2% with steel fibers the combine effect of flyash, RHA and steel fibers are carried out. A 150x150 mm concrete cube was used as test specimens to determine the compressive strength of concrete cubes. The ingredients of concrete were thoroughly mixed till uniform consistency was achieved. The cubes were properly compacted. All the concrete cubes were de-moulded within 24 hours after casting. The de-moulded test specimens were properly cured in water available in the laboratory at an age of 28 days. Compression test was conducted on a 200 Ton or 2000 KN capacity universal testing machine. The load was applied uniformly until the failure of the specimen occurs. The specimen was placed horizontally between the loading surfaces of the compression testing machine and the load was applied without shock until the failure of the specimen occurred.

IV. RESULT & DISCUSSION

Results obtained from experimental investigation to study the properties of ternary blended FRSCC are discussed in detail as given below.

Workability parameters of Ternary Blended SCC

Test Method	Property	Unit	Min	Max	% of RHA (30% FA)					
					0%	**4%**	**6%**	**8%**	**10%**	**12%**
Slump flow	Filling ability	mm	650	800	710	695	698	680	675	675
T50 slump flow		sec	2	5	3.3	4.0	4.5	5.0	5.1	5.4
V-funnel	Filling ability	sec	6	12	7.3	7.6	7.8	8.0	8.7	9.8
L-Box	Passing ability	%	0.8	1.0	0.82	0.85	0.88	0.86	0.90	0.92

Workability parameters of SFRSCC(FA30 RHA6)(Aspect ratio= 80/60)

Test Method	Property	Unit	Min	Max	% of fibers				
					0%	**0.5%**	**1.0%**	**1.5%**	**2.0%**
Slump flow	Filling ability	mm	650	800	698	685	680	660	640
T50 slump flow		sec	2	5	4.5	4.5	5.2	5.0	5.5
V-funnel	Filling ability	sec	6	12	7.8	7.4	7.8	9.8	10.00
L-Box	Passing ability	%	0.8	1.0	0.88	0.92	0.94	0.90	0.92

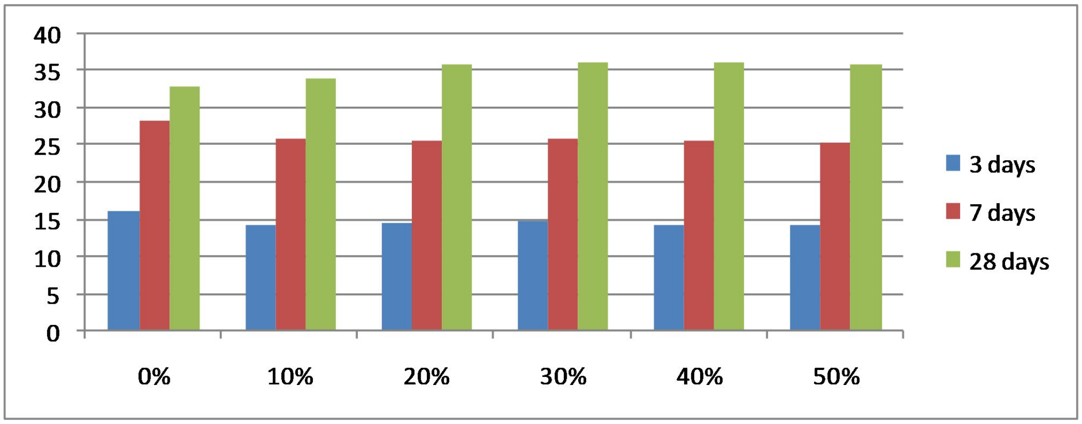
Compressive Strength of fly ash

The values of compressive strength of fly ash based concrete. The specimen tested after 3 days, 7 days, and 28 days curing. In which the maximum Compressive Strength occurred at F30.

[Satyanarayana , 4(1): January 2017] ISSN 2348 – 8034
DOI- 10.5281/zenodo.263966 Impact Factor- 4.022

Sl.No.	Specimen	Strength in n/mm^2			Avg. Strength in n/mm^2		
		3 days	7 days	28 days	3 days	7 days	28 days
1.	F0	16.88	29.55	35.19		28.4	32.90
2.		15.60	28.00	32.07	16.31		
3.		16.45	28.80	34.00			
1.	F10	14.56	27.2	32.79		26.00	33.96
2.		14.28	25.00	34.17	14.40		
3.		14.37	25.80	34.92			
1.	F20	14.88	26.04	36.92		25.80	35.82
2.		14.46	25.04	36.25	14.50		
3.		14.30	25.96	34.29			
1.	**F30**	14.90	26.08	36.92		**26.02**	**36.29**
2.		15.26	25.92	35.98	**14.89**		
3.		14.47	26.06	35.97			
1.	F40	14.71	25.44	36.89	14.32	25.60	36.12
2.		14.44	25.92	35.83	14.32		
3.		13.81	25.44	35.65			
1.	F50	14.61	25.90	36		25.37	36
2.		13.94	24.19	36	14.29		
3.		14.32	26.02	36			

THOMSON REUTERS ENDNOTE
[Satyanarayana , 4(1): January 2017] ISSN 2348 – 8034
DOI- 10.5281/zenodo.263966 Impact Factor- 4.022



Compressive Strength of % of fly ash

Compressive Strength of Ternary Blended SCC

The values of compressive strength of Ternary Blended SCC. The specimen tested after 3 days, 7 days, and 28 days curing. In which the maximum Compressive Strength occurred at F30RHA6.

Sl.No.	Specimen	Strength in n/mm^2			Avg. Strength in n/mm^2		
		3 days	7 days	28 days	3 days	7 days	28 days
1.	F30RHA0	14.90	26.08	36.92	14.89	26.02	36.29
2.		14.47	25.92	35.98			
3.		15.26	26.06	35.97			
1.	F30RHA2	14.68	25.70	37.74	14.50	25.80	37.16
2.		13.95	25.70	36.87			
3.		14.87	26.00	36.87			
1.	F30RHA4	14.11	25.33	38.00	14.23	25.25	37.96
2.		14.28	25.33	37.77			
3.		14.32	25.11	38.13			
1.	**F30RHA6**	15.23	26.66	39.02	**14.74**	**26.06**	**39.59**
2.		14.66	25.77	40.00			
3.		14.35	25.77	39.77			
1.	F30RHA8	14.60	25.55	39.55	14.19	25.47	39.24
2.		14.11	25.55	38.22			
3.		13.87	25.33	39.55			

1.	F30RHA10	13.96	24.44	38.22	14.01	24.74	38.14
2.		14.48	25.34	38.45			
3.		13.61	24.34	37.77			

Compressive Strength of % of rice husk ash

Compressive Strength of Fiber Reinforced SCC

the values of compressive strength of Fiber Reinforced SCC. The specimen tested after 3 days, 7 days, and 28 days curing. In which the maximum Compressive Strength occurred at F30RHA6 and 1.5% of steel fibers added.

Sl.No.	Specimen	%Of Steel Fibres	Strength in n/mm^2			Avg. Strength in n/mm^2		
			3 days	7 days	28 days	3 days	7 days	28 days
1.	F30RHA6	0%	13.13	26.66	39.02	12.82	26.06	39.59
2.			12.36	25.77	40.00			
3.			12.97	25.77	39.77			
1.	F30RHA6	0.5%	12.63	30.02	41.11	12.52	29.64	40.66
2.			13.09	28.88	40			
3.			11.84	30.02	40.88			
1.	F30RHA6	1%	12.67	30	40	12.89	30	39.84
2.			13	30	39.77			

3.			13	30	39.77			
1.	**F30RHA6**	**1.5%**	13.47	31.11	42.22		**34.74**	**42.22**
2.			13.23	30.66	42.44	**13.57**		
3.			14.01	31.11	42			
1.	F30RHA6	2%	12.45	30.66	42		30.51	41.66
2.			13.62	30.44	41.7	13.23		
3.			13.62	30.44	42			

Compressive Strength of % of fiber

V. CONCLUSION

Based on the experimental investigations the following conclusions are drawn:

- This study shows that Flyash and Rice Husk Ash can be used as replacement to cement in SCC.
- By using RHA heat of hydration is reduced and also cost analysis shows not much variation in cost, though it is economic than ordinary concrete.
- Optimum percentage of SCC mix containing RHA and Fly Ash as partial replacement of cement was found to be 6% and 30%.
- Ternary mix exhibited better consistency in compressive strength development, which indicates a synergy of inert particle interaction between Ordinary Portland Cement, Rice Husk Ash and Fly Ash which enhanced compressive strength property.
- The Dramix steel fibers are suitable for SCC up to 2% by volume of concrete.
- The Dramix steel fibers of aspect ratio 80/60 have shown overall improvements of all the properties.
- This study has shown that FRSCC can also be applied locally for construction of concrete pavements, base slabs which require not much higher strength.

[Satyanarayana , 4(1): January 2017] ISSN 2348 – 8034
DOI- 10.5281/zenodo.263966 Impact Factor- 4.022

VI. ACKNOWLEDGEMENTS

the author D.Satyanarayana and A.Jeevan raju wish to thank Mr.Mohmmed.Shahebaz ,head of the department of civil engineering for their kind support, valuable guidance and providing all facilities for conducting this experiment on comparative study on strength of ternary blended fiber reinforced self-compacting concrete.

REFERENCES

*1. **IS 456 -2000** "Code of Practice for Plain and Reinforced Concrete", Bureau of Indian Standards, New Delhi.*
*2. **IS 516 -1959** "Methods of Tests for strength of concrete", Bureau of Indian Standards, New Delhi.*
*3. **IS 10262 -2009** "IS Method of Mix Design", Bureau of Indian Standards, New Delhi.*
4.concrete technology by M.S Shetty
5.properties of concrete by Neville