International Journal of Engineering Research and General Science Volume 4, Issue 6,November-December, 2016
ISSN 2091-2730

PERFORMANCE OF PARTIAL REPALCEMENT OF FINE AGGREGATE WITH QUARRY DUST AND CEMENT WITH FLYASH ON SELF COMPACTING CONCRETE

G.MAHESWARA REDDY, G.PRIYATHAM REDDY

Department of structural engineering, Loyola Institute of Technology and Management, JNTUK

Email: mahesh.gogireddy@gmail.com

ABSTRACT: Self-compacting concrete (SCC) is a flowing concrete that spreads through congested reinforcement, fills every corner of the formwork, and is compacted under its self weight.SCC requires excellent filling ability, good passing ability, and adequate segregation resistance. The present study focuses on utilization of quarry dust and fly ash in SCC as a partial replacement of fine aggregate and cement respectively. In this project, work done on experimental study on fresh and hardened properties such as flow ability, passing ability, compressive, tensile and flexural strength of M40 grade of SCC. In this investigation SCC was made with partially replacing fine aggregate with quarry dust and cement with fly ash.

INTRODUCTION:

In this investigation SCC was made with partially replacing fine aggregate with quarry dust and cement with fly ash. Six mixes with different percentages of quarry dust (0%, 10%, 20%, 30%, 40%and 50%) as partial replacement for sand 30% of fly ash as partial replacement for cement is considered. For each mix workability and hardened tests are carried out respectively. The test results for hardened properties are carried out at 3,7,28 days respectively. The results obtained regards the possibility for obtaining the SCC using quarry dust and fly ash, and also studied its variation in strength properties for different percentages of quarry dust. Concrete that flows and settles due to its own weight without segregation and bleeding are called SCC. In recent years SCC has gained wider applications as it reduces the time period of construction.In SCC, no vibration is required for the compaction. It flows like "honey" and after placing it has a very smooth surface. SCC and NVC consists of the same constituent elements namely cement, aggregates and water, with the addition of chemical and mineral admixtures in varying proportions.SCC mixes usually contains super plasticizer in form of high range water reducer (HRWR) and viscosity modifying additive (VMA). In the SCC use of super plasticizers (HRWR) maintains the fluidity; VMA provides stability of the mix, resulting in high resistance against bleeding.

Comparison Of NC and SCC:

- Normal concrete cannot reach every hook and corner of the structures while this provision can be satisfied by self compacting concrete. Smooth finish can be obtained without any external equipment. For the purpose of the normal concrete this is not possible.
- In terms of the hardened properties, at similar water/cement ratio, properly proportioned, produced and placed SCC is generally denser and less variable than the equivalent conventional vibrated concrete, thereby resulting in improved strength and durability performance.

METHODOLOGY:

The methodology adopted for experimental work includes

- Mix proportioning for SCC to achieve high flow ability without segregation and bleeding using chemical admixture and fly ash.
- Quarry dust as fine aggregate will be used, in different dosages to study the flow ability and strength of the mix proportions.
- Slump flow test, V-Funnel test and L-Box test will be conducted to find out the ability to pass, ability to fill and resistance to segregation of SCC.
- The test results will be compared with the limits of European standards recommended by EFNARC.
- Hardened concrete tests will be conducted to determine the strength characteristics of SCC.

Testing methods for workability properties Of SCC :

Sl.	Method	Property
1	Slump-Flow	Filling ability
2	T_{50cm} Slump Flow	Filling ability
3	V-Funnel	Filling ability
4	V-Funnel At $T_{5minutes}$	Segregation resistance
5	L-Box Passing	Passing ability
6	U-Box Passing	Passing ability

Testing methods for hardened properties Of SCC :

Sl.	Method	Property
1	Compressive strength	Compressive strength
2	Split tensile strength	Tensile strength
3	Flexural strength	Flexural strength

ACCEPTANCE CRITERIA FOR SCC:

These typical requirements shown each test method are based on European code SSC specification and practice

Sl.	Method	Unites	Typical Range of values	
			Minimum	Maximum
1	Slump-flow by Abrams cone	mm	650	800
2	T_{50cm} slump flow	sec	2	5
3	V-funnel	sec	6	12
4	V-funnel at $T_{5minutes}$	sec	0	3
5	L-box Passing	(h_2/h_1)	0.8	1.0
6	U-box Passing	(h_2-h_1)mm	0	30
7	J-ring Passing	mm	0	10

EXPERIMENTAL PROGRAME:

- MATERIAL PROPERTIES

- CEMENT:

The Cement used was Jaypee Ordinary Portland Cement (OPC) of grade 43 conforming to IS: 8112-1989. The various laboratory tests confirming to IS: 4031-1996 (PART 1 to 15) specification was carried out .

- FLY ASH AS CEMENTESIOUS MATERIAL

Fly ash samples taken from NTPC Visakhapatnam are used in this study. Fly ash was not processed and, used as received. The sample satisfied the requirements of IS 3812(Part I).

PHYSICAL PROPERTIES OF CEMENT AND FLY ASH :

Sl no.	Physical Properties	Observed value for cement	Observed values for fly ash
1	Specific Gravity	3.14	2.2
2	Initial Setting (minutes)	38 min	45 min
3	Final Setting (minutes)	600 min	280 min
4	Consistency (%)	30%	35%
6	Fineness	9.25%	31.5%

FINE AGGRIGATES:

Property	value
Specific gravity	2.63
Fineness modulus	2.60
Water absorption	2.56

QUARRY DUST:

Specific gravity	2.75
Water absorption	0.85%

COARSE AGGREGATE:

Test property	Natural coarse aggregate
Specific gravity	2.87
Water absorption	0.25%

CHEMICAL ADMIXTURE:

Poly carboxylic ether based super plasticizer with viscosity modified admixture with a brand name of Master Glenium SKY 8630/8632 was used in the present research work. Master Glenium SKY 8630/8632 is an admixture of a new generation based on modified Poly carboxylic ether which produces Self Compacting Concrete with inbuilt Viscosity Modifying admixture.

Aspect	Light brown liquid
Relative density	1.08 ± 0.01 at 25ºC
pH	≥ 6 at 25ºC
Chloride ion content	< 0.2%

Mix-design :

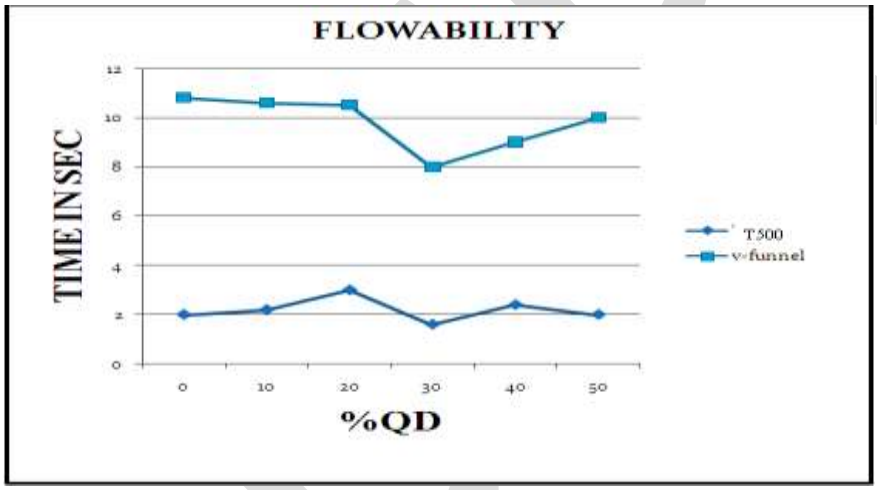
Mix proportion M40

Mix no	Cement(kg)	% fly ash	%QD replaced	QD(kg)	W/B ratio	CA(kg)	FA(kg)	Water(lit)	% admixture
1	270	30	0	0	0.36	1017.2	925.3	168	5.94
2	270	30	10	98.36	0.36	1017.5	832.8	166.3	5.94
3	270	30	20	196.82	0.36	1017.5	740.2	164.7	5.94
4	270	30	30	295.27	0.36	1017.5	605.5	163.12	5.94
5	270	30	40	393.7	0.36	1017.5	555.26	161.5	5.94
6	270	30	50	492.3	0.36	1017.5	461.7	160.4	5.94

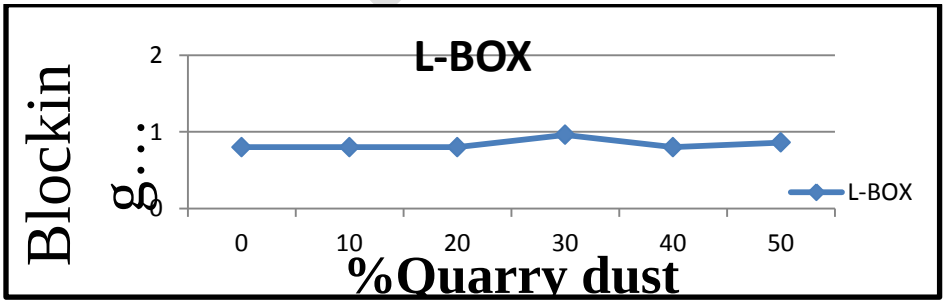
RESULTS AND DISCUSSIONS:

- **Workability Test Results**

Mix no	% QD	slump flow test (t in sec)		L value(h_2/h_1)	v (t in sec)
		500mm	700 mm		
1	0	2	4	0.8	10.8
2	10	2.2	6	0.8	10.6
3	20	3	8.6	0.8	10.5
4	30	1.6	7.8	0.96	8
5	40	2.4	11.5	0.8	9
6	50	2	9	0.86	10



At 30% Partial replacement of fine aggregate by quarry dust the time of flow in slump flow test and in V Funnel test was observed to be minimum.

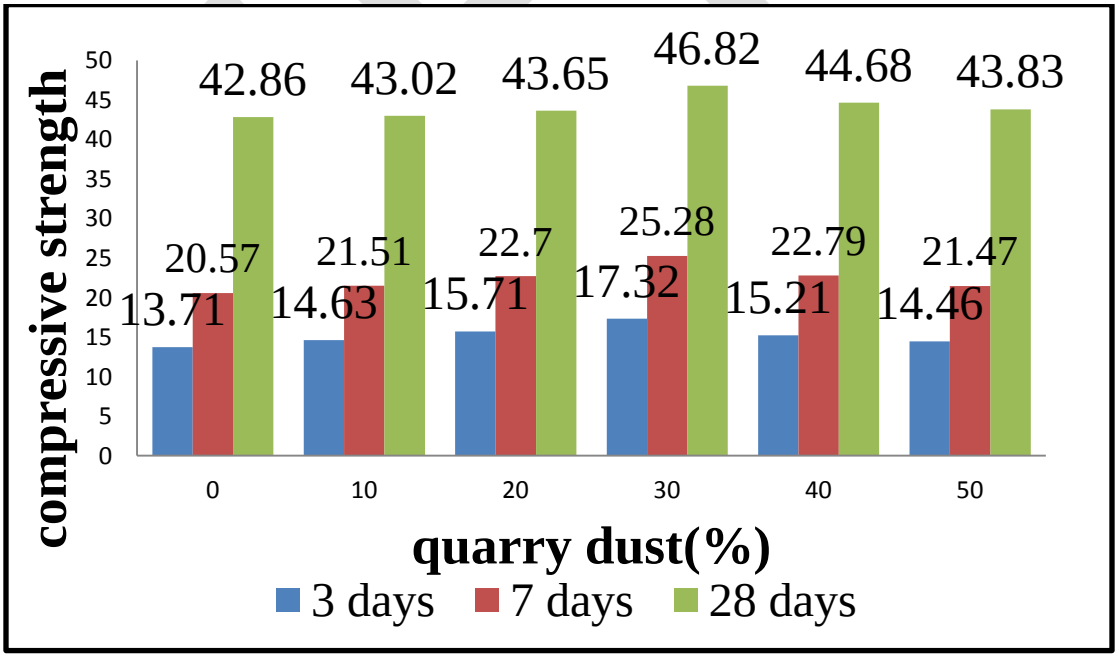


- The lower results at higher percentage of partial replacement of fine aggregate is attributed to the fact that, there is reduction in the free water content in the SCC mix due to high water absorption of quarry dust. In all the six SCCs mixes, No segregation and bleeding were observed.

- However all the three flow ability tests were within the acceptable limits of EFNARC (2002). Moreover, the fresh concrete properties obtained from slump flow, V-funnel test, L-box provided the same trend for all SCC mixes.

COMPRESSIVE STRENGTH TEST RESULTS:

Mix no	% QD	Compressive strength(Mpa)		
		3days	7days	28days
1	0	13.71	20.57	42.86
2	10	14.63	21.51	43.02
3	20	15.71	22.7	43.65
4	30	17.32	25.28	46.82
5	40	15.20	22.79	44.68
6	50	14.46	21.47	43.83

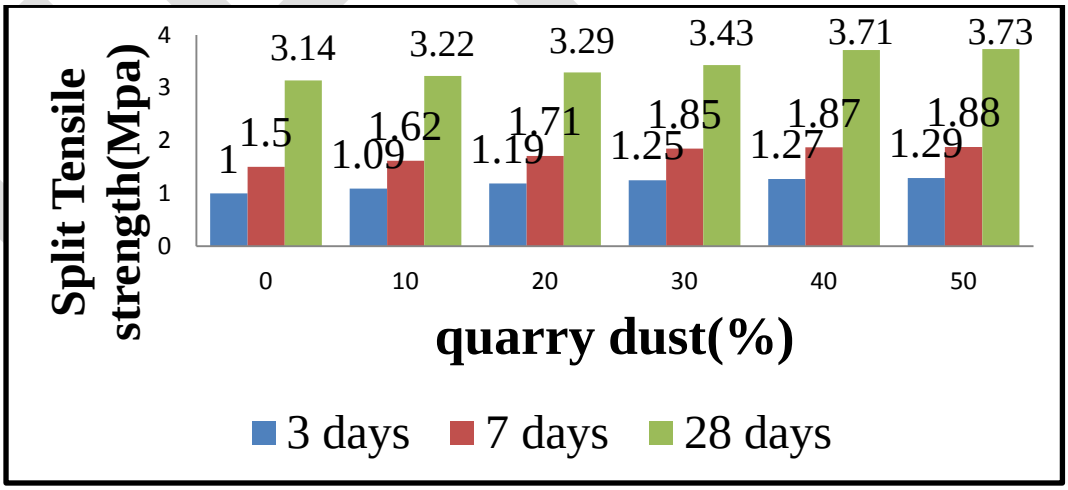


- Examining the strength at 28 days age it can be seen that increasing the quarry dust content from 0% to 20 % has caused increase in compressive strength by 2% as compared to reference mix.

- But when the quarry dust replacement was increased to 30%, the compressive strength increase was almost 8%.An increase in quarry dust content from 30% to 50% reduced the compressive strength by 7% when compared to 30% replacement of quarry dust with river sand.

SPLIT TENSILE STRENGTH TEST RESULTS:

Mix no	% QD	Split Tensile strength		
		3days	7days	28days
1	0	1	1.5	3.14
2	10	1.09	1.62	3.22
3	20	1.19	1.71	3.29
4	30	1.25	1.85	3.43
5	40	1.27	1.87	3.71
6	50	1.29	1.88	3.62

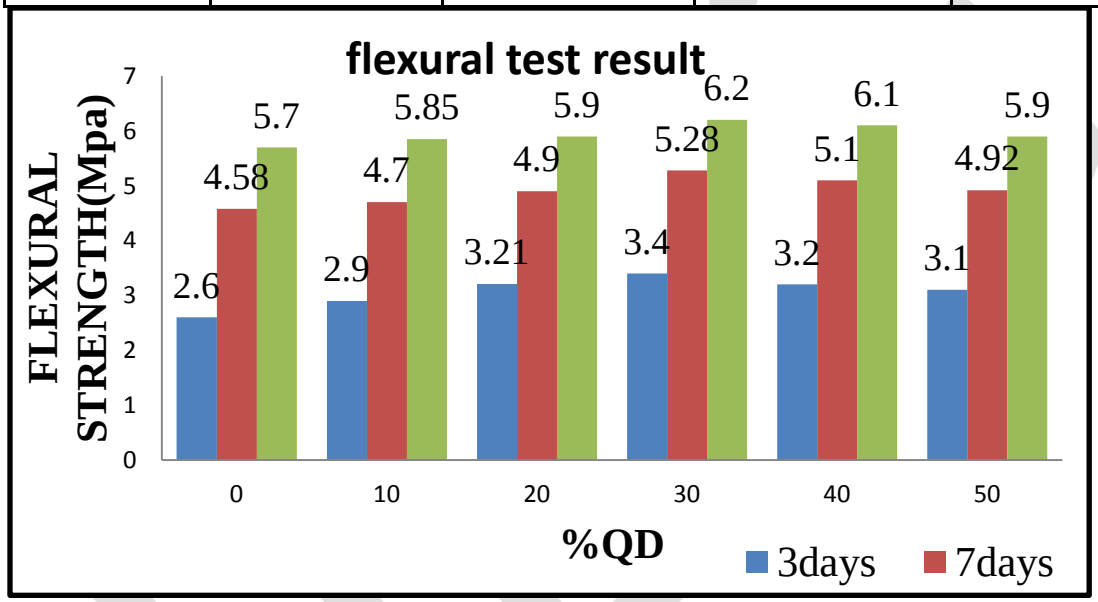


- It is clear that the splitting-tensile strengths of quarry dust SCC mixtures are increasing. The increase was almost 8% at 30% partial replacement while it was almost 15% at about 40% partial replacement.

FLEXURAL STRENGTH TEST RESULTS :

Mix no	% QD	Flexural strength(Mpa)

		3days	7days	28days
1	0	2.6	4.58	5.7
2	10	2.9	4.7	5.85
3	20	3.21	4.9	5.90
4	30	3.4	5.28	6.20
5	40	3.2	5.10	6.10
6	50	3.1	4.92	5.9



- Examining the strength at 28 days age it can be seen that increasing the quarry dust content from 0% to 20 % has caused increase in flexural strength by 3% as compared to reference mix.
- But when the quarry dust replacement was increased to 30%, the flexural strength increase was almost 8 to 9%. An increase in quarry dust content from 30% to 50% reduced the flexural strength by 5% when compared to 30% replacement of quarry dust with river sand.

CONLUSIONS:

From the present investigation following are the conclusions derived

- ❖ The slump flow varied between the ranges of 650-725mm. At 30% partial replacement of fine aggregate by quarry dust minimum flow time of 1.6sec and 8 sec was observed in slump flow and v-funnel test respectively.
- ❖ However all the three workability tests were within the acceptable limits of EFNARC.
- ❖ For compressive strength test, with increase in percentage partial replacement of fine aggregate with quarry dust at 10%, 20% and 30%, observed the increase in compressive strength by 1%, 2% and 8% respectively. Further with increase in percentage

partial replacement of fine aggregate with QD at 30 to 40% and 30 to 50% decreased the strength gradually by 5% and 7% respectively.

- Similarly in case of split tensile test with increase in percentage partial replacement of FA with QD at 10%, 20%, 30%, 40% increased the strength by 2%, 4%, 8%, 15% respectively. Further with increase in partial replacement from 40 to 50% has decreased the strength by 2%.

- Similarly for flexural strength test increase in strength by 2%, 3% and 8% are observed with increase in partial replacement of FA with QD at 10%, 20% and 30% respectively. Further with increase in partial replacement from 30% to 40% and 30 to 50% has decreased the strength by 2% and 5% respectively.

- From all the results and points discussed above it can be concluded that the fly ash and quarry dust replacement showed the desirable results that can suggest the usage of the quarry dust as replacement of sand.

- From overall view it can also be concluded that the partial replacement of quarry dust beyond 30%, there will be decrease in the compressive strength and flexural strength values of cube and prism specimens where as in case of split tensile test decrease in strength is observed with partial replacement of FA by QD beyond 40%.

REFERENCES:

1. Celik and Marar(1996) report on properties of SCC with quarry dust as partial replacement.
2. Naidu et al. (2003a) report on experimental study on concrete with partial replacement of fine aggregate with QD.
3. Murugesan et al. (2006) report on strength properties of concrete with QD as partial replacement for FA.
4. Ilangovan et.al (2008) Strength And Durability Properties Of Concrete Containing Quarry Rock Dust As Fine Aggregate