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A Study On Use Of Recycled Concrete Aggregate As Partial Replacement For Natural Aggregate

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Abstract -- *In this paper an attempt is made to examine the possibility of using recycled concrete aggregate (RCA) as a substitute to natural aggregate (NCA). In the second part of the paper concrete specimens were cast by partially replacing cement by silica fume, and NCA was replaced by 30% RCA. 20% replacement of cement by fly ash gave the optimum results*.

1. INTRODUCTION

In recent years demolitions of old structure have increased as many of old buildings have become obsolete Natural disasters such as earth quake and cyclones also increased the amount of waste construction material. Most of there waste building materials are used to bill be land bills. The open land available for dumping waste gets reduced now it is very difficult to dispose there waste building materials. An alternate solution is to recycle the waste building materials namely the concrete into aggregates. Fly ash is an industrial by product resulting from combustion of pulverized coal. The amount of cement produced in India is estimated to be 3.2 billion tons by 2020 which world tend to about 3.2 billion tons of CO_2 release. In order to reduce the usage of cement, fly ash is used as partial replacement for cement. Fly ash is an industrial by product of thermal power Plant and posses good pozzolanic actually.

2. SCOPE OF THE STUDY

In this paper an attempt is made to examine the possibility of using recycled concrete aggregate (RCA) as a substitute to natural coarse aggregate (NCA).In the second part of the experimental investigation mechanical properties of concrete made with fly ash as a partial replacement of cement in proportions of 0%, 10, 20 and 30% at water binder ratio of 0.4 was studied with recycled concrete aggregate as a partial replacement of natural coarse aggregate.

3. MATERIALS USED

3.1. Cement – Ordinary Portland cement 43 grade
3.2. Fly ash – Class F Fly ash
3.3. Coarse aggregate – 70% Natural coarse aggregate and 30% recycled concrete aggregate passing through 20mm sieve and retained on 10mm sieve
3.4. Fine aggregate – Locally available river sand
3.5. Water – potable water.
3.6. Superplastisizer - CONPLAST SP430

TABLE I

MECHANICAL PROPERTIES OF NATURAL COARSE AND RECYCLED CONCRETE AGGREGATE

Proportions	100% NCA	90% NCA+10% RCA	80% NCA+20% RCA	70% NCA+30% RCA	60% NCA +40% RCA	50% NCA+50% RCA	Maximum Permissible values as per IS 2386 Part IV (%)
Aggregate impact value (%)	16	22	23.6	24.7	25.8	26.2	30
Los angles abrasion value (%)	24	25.1	28.2	29.8	33	36	30
Aggregate crushing value (%)	24.2	25.3	26.4	27	28.2	30	30

4. MIX PROPORTIONS

In the first part of the study natural coarse aggregate. Details of mix proportion used are given in table II.

Cement is partially replacement by fly ash in the range of 0 - 30% was water binder ratio of 0.40 was used in the second part of study. Detail proportion of mix is given in table III.

TABLE II

TRIAL MIX PROPORTIONS

Mix	Cement (Kg/m3)	Fine aggregate(Kg/m^3)	Natural coarse aggregate (Kg/m^3)	Recycled concrete aggregate(Kg/m^3)	Water (litres)
TM_1	487	686.2	1024	0	185
TM_2	487	686.2	921.6	102.4	185
TM_3	487	686.2	813.2	204.8	185
TM_4	487	686.2	716.8	307.2	185
TM_5	487	686.2	614.4	411.6	185
TM_6	487	686.2	512	512	185

TABLE III

MIX PROPORTIONS OF OPTIMIZED MIX USING 30% RCA(m^3)

Sl. no	% of fly ash content	Cement (kgs)	Fly ash (kgs)	Fine aggregate (kgs)	Natural aggregate (kgs)	Recycled aggregate (kgs)	Water (lit)
M1	0	463.0	0	708	716.80	307.2	185
M2	10	416.7	46.3	708	716.80	307.2	185
M3	20	370.4	97.4	708	716.80	307.2	185
M4	30	324.1	146.1	708	716.80	307.2	185

5. SPECIEMEN CASTING AND CURING

150X150X150 mm cubes, 100X100X500 mm prisms and 150mm dia X 300 mm cylinders were cast in steel moulds and compacted using vibration table. After 24 hours cubes prisms and cylinders were remolded and kept in curing tank.

6. RESULTS AND DISCUSSIONS:

The results of aggregate impact value, Los angles abrasion and aggregate crushing value for the various proportions of recycled concrete aggregate are given in table I. The results indicate that up to 30% level RCA can be used to replace NCA. Compressive strength results of trial mixes are given in table IV. From the results it is clear that with the increase in RCA content the compressive strength reduces.

6. TABLE IV

COMPRESSIVE STRENGTH FOR TRIAL MIXES AT 28 DAYS

Proportions	TM 1	TM 2	TM 3	TM_4	TM_5	TM_6
Compressive strength (MPa)	49.00	47.90	45.90	45.38	42.15	39.40

TABLE V

MECHANICAL PROPERTIES OF OPTIMIZED MIX USING 30% RCA

Properties	CC	M_1	M_2	M_3
Comp. Strength (MPa)				
7 days	26.66	26.98	26.32	25.88
28 days	42.92	41.33	41.88	39.78
56 days	45.92	45.44	45.23	42.86
Split tensile strength (MPa)	3.34	3.45	3.52	3.73
Flexural Strength (MPa)	4. 66	4.85	5.08	5.16

The results of compressive strength, split tensile strength and flexural strength of concrete made up of fly ash as partial replacement of cement are given in table V. When compared to control mix fly ash mixes had increase of 5- 10 % of compressive strength at 28 days. Maximum compressive strength is achieved with 20% replacement of fly ash. With the increase in age the compressive strength also increases.

Maximum split tensile strength was achieved with 20% of fly ash and there after the strength reduced. It was observed that split tensile strength was about 7 to 8 % of compressive strength.

The flexural strength of various mixes varies from 4.66 MPa to 5.16 MPa. Maximum flexural strength was achieved when cement is replaced by 20% of fly ash.

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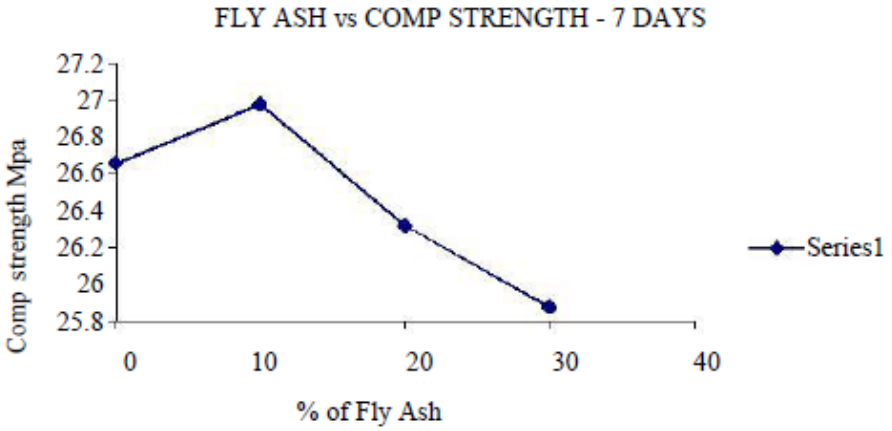
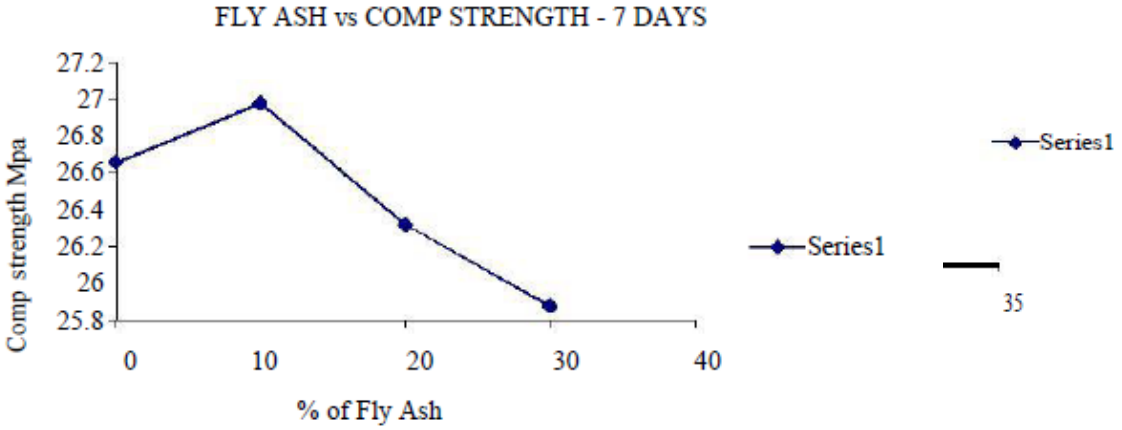
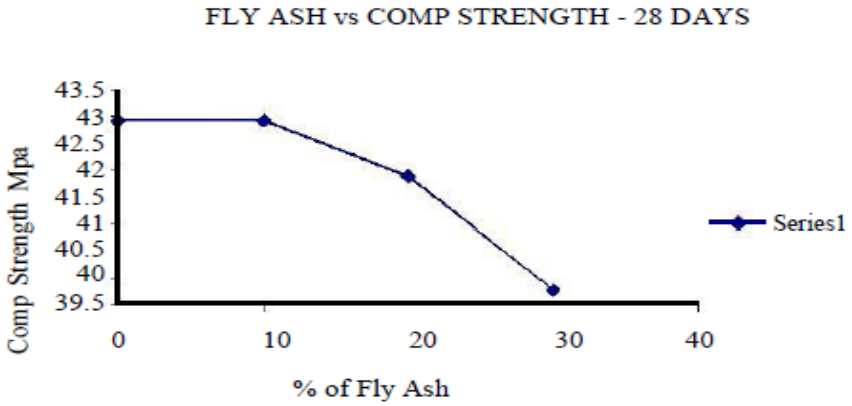


FLY ASH vs COMP STRENGTH - 56 DAYS





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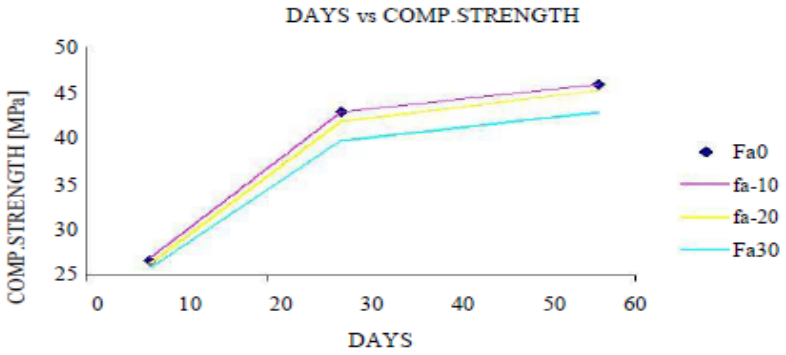

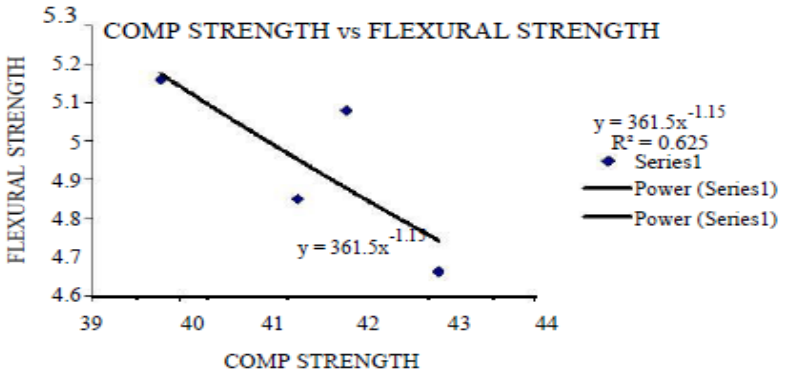

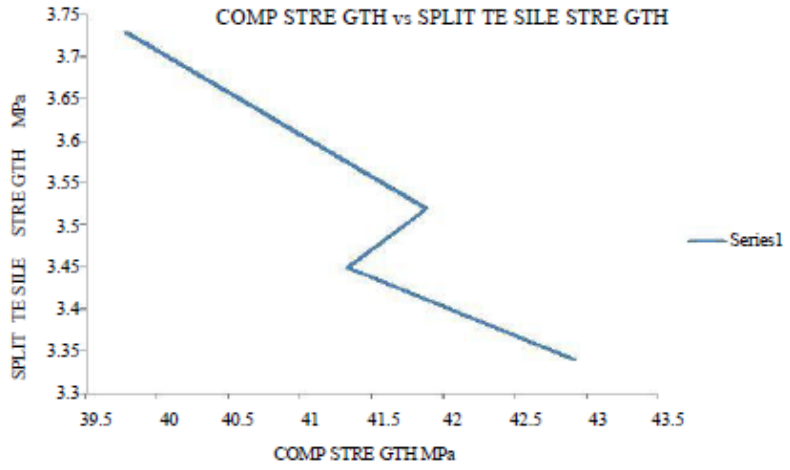

7. CONCLUSIONS

Replacement of natural coarse aggregate by recycled concrete aggregate reduces the strength of the concrete by. Up to 30% replacement of natural coarse aggregate by recycled concrete aggregate can be done as it satisfies IS requirements. Optimum level of replacement of cement by fly ash is found to be 20% to obtain better compressive strength, split tensile strength and flexural strength Partial replacement of natural coarse aggregate with recycled concrete aggregate and cement by fly ash leads to considerable savings in cost. More over the replacement can solve the environmental issues related to disposal of recycled concrete aggregate and fly ash. Hence it can be concluded that replacement of cement with 20% of fly ash and natural coarse aggregate by 30% of recycled concrete aggregate can be done.

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