An Experimental Study on Mechanical Properties of Blended Cement Concrete

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Abstract- *Fly ash is one of the residues generated from thermal power plants. Fly ash can be used as a low cost mineral admixture in concrete. The addition of fly ash in cement resulted in great benefits such as reduction in heat of hydration, resistance to corrosion, reduction of cement consumption and decreased permeability. M25 grade of concrete is prepared with high volume fly ash and quarry dust in concrete with various proportions as a partial replacement of cement 0% 10%,20%,30%and 40%. To study the mechanical properties of high volume of fly ash and quarry dust in concrete. Various parameters have been made to know the compressive strength, split tensile strength and flexural strength at different ages of concrete such as 7 and 28 days. The result shows that the optimum replacement of fly ash and quarry dust are at 30%.*

Keywords- Concrete, Quarry dust, Fly ash, M- sand, Mechanical properties.

I. INTRODUCTION

Concrete is one of the most commonly used building materials in the construction fields. Concrete has good service records in the construction fields. In the concrete is the widest building material and the constituents are coarse aggregate, fine aggregate, binding materials,admixtures and water. It is a versatile material that can be easily mixed to meet the variety of special needs and it is formed virtually at any shape. This paper presents the viability of the usage of quarry rock dust and fly ash as percent substitutes for conventional M25 grade concrete. Currently in India, it is estimated that the annual consumption of cement concrete is to the tune of 400 metric tons. River sand is common form of fine aggregate used in the production of concrete but has become very expensive due to rapid depletion of river bed, high transportation cost etc., using alternative materials in place of natural aggregate in concrete production makes concrete a sustainable and environmentally friendly construction material. The sand is becoming a very scarce material, in this situation a easily available alternative material is used instead of natural sand. A comparatively good strength is expected when m-sand is replaced instead of river sand with or without admixtures. The sand is replaced with the locally available materials to give strength and workability to the concrete. Quarry dust is a waste material obtained from quarries while crushing. Investigation has been taken place to know the potenciality of the quarry dust as fine aggregate in concrete in construction. The crusher dust is used as a replacement material to reduce the cost of construction when compared with the river sand.

II. MATERIAL PROPERTIES

CEMENT:

OPC (Ordinary Portland Cement) 53 Grade of ACC confronting to IS 269:1967, IS 4031:(I)1988 and IS 4031-(IV)-1988 adopted in this work. Test conducted on Cement are as follow,

CEMENT OPC 53 GRADE

Table I: Cement

PARTICULARS	PERMISSIBLE VALUES	TEST RESULTS	IS CODE
FINENESS TEST	≤10%	6%	IS 4031-(I)-1988
CONSISTENCY TEST	26-34%	29%	IS 4031-(IV)-1988
INITIAL SETTING TIME	30 mins	30 mins	IS 269 – 1967
FINAL SETTING TIME	600 mins	600 mins	IS 269 – 1967
SPECIFIC GRAVITY	>10mm	3.14	

COARSE AGGREGATE:

The aggregates used are locally available. The aggregate used are 20mm size. The coarse aggregate are tested to know the strength of the material. The test conducted on aggregate are as in Table II.

Table II: Coarse aggregate

SL.NO	TEST	TEST RESULTS
1.	Size of aggregate	20mm
2.	Crushing value	18.44%
3.	Impact value	15%
4.	Abrasion value	20%
5.	Flakiness index	20%
6.	Elongation index	21%

FINE AGGREGATE:

Fine aggregate is natural sand which has been washed and sieved to remove particles larger than 5 mm. Sand consists of small angular grains of silica. Sand is used as fine aggregate in construction

Table III: Fine aggregate

SL.NO	TEST	RESULT	IS REQUIREMENT
1.	Specific gravity	2.57	As per IS 2720:pt-3 Max. 2.53 to 2.67
2.	Fineness test	7.5%	-
3	Sieve analysis	3.21%	-

MANUFACTURED SAND (M-Sand):

Manufactured sand is commonly replaced as fine aggregate. Manufactured sand was tested as per Indian standard specification. The manufactured sand is brought from the nearby area for construction.

Table IV: Test on Manufactured Sand

Sl.No	Property	Value
1.	Initial setting time in min	30mins
2.	Final setting time in min	600mins
3.	Specific gravity	3.2
4.	Fineness of cement by sieve	3.3

Figure 1: M-Sand

FLY ASH:

Fly ash or flue ash, also known as pulverised fuel ash in the United Kingdom, is a coal combustion product that is composed of the particulates that are driven out of coal-fired boilers together with the flue gases.

Figure 2: fly ash

Table V: Physical Properties of fly ash

s.no	replacement	7th day test	28th day test
1	10%	380	789
2	20%	389	791
3	30%	400	810

CONCRETE MIX DESIGN:

The M20 grade with nominal mix design as per IS 456-2000 was used in the concrete mix . The concrete mix proportion (Cement: Sand: Coarse Aggregate) is 1: 1: 2 by weight and a water cement ratio of 0.45.

III. RESULTS AND DISCUSSION:

Workability test results:

SLUMP TEST

Table VIII: SLUMP CONE VALUE

w/c ratio	Slump value in cm
0.38	0
0.4	2.5
0.42	3.2
0.44	5
0.46	7

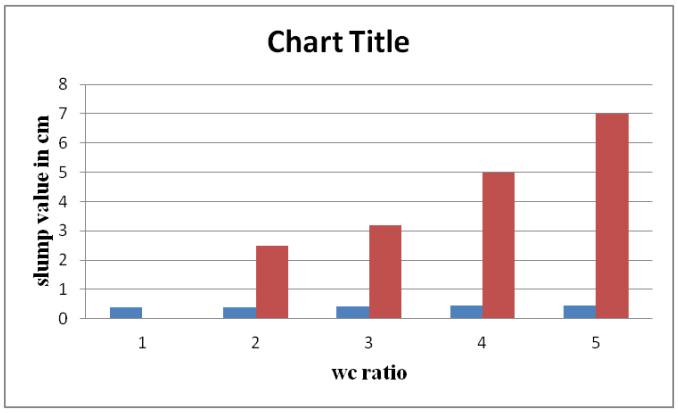

Figure 3: Slump cone test

CUBE

Table IX: Test results of compressive strength

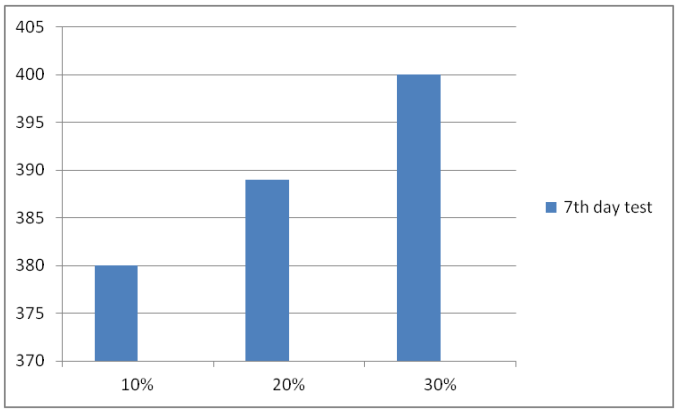

Figure 4:7th day test results

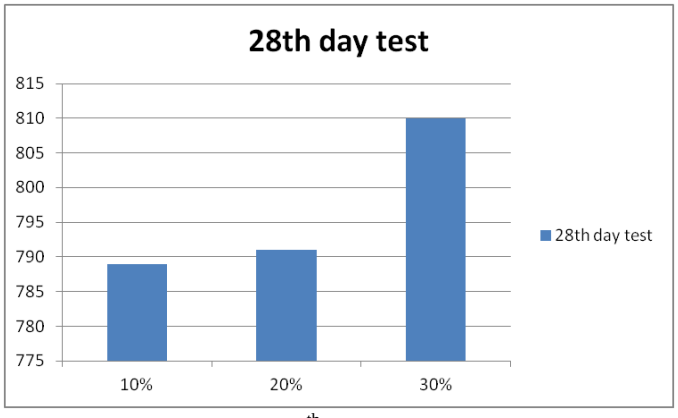

Figure 5 28th day test results

The value variation of compressive strength of cubes for the partial replacement of Fine aggregate with fly ash and quarry dust increased values in the order of after 28 days 35.06, 35.15, 36 for 10%, 20% and 30% fly ash and quarry dust proportions replacements respectively.

CYLINDER

Table X-Test results of spilt tensile strength

% Replacement of fly ash and quarry dust	Ultimate load (kN)	Split tensile test of concrete at the age of 28 days (N/mm2)	Average Split tensile test(N/mm2)
10%	195	2.75	2.75
20%	200	2.83	2.83
30%	213	3.01	3.01
40%	207	2.92	2.92

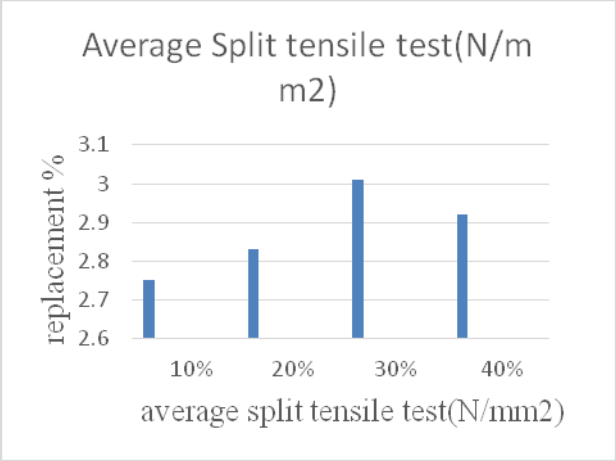

Figure 6: Result of 28 days

The value variation of spilt tensile strength of cylinder for the partial replacement of Fine aggregate with fly ash and quarry dust increased values in the order of after 28 days 2.75, 2.83, 3.01, 2.92 for 10%, 20%, 30% and 40% fly ash and quarry dust proportions replacements respectively.

PRISM

Table XI- Test results of flexural strength

% Replacement of fly ash and quarry dust	Ultimate load(kN)	Flexural strength of concrete (N/mm²)	Average Flexural strength(N/mm2)
0%	20	1.35	1.92
	21	1.92	
	20	1.35	
10%	18	1.57	1.57
	17.5	1.55	
	17	1.50	
20%	18	1.57	1.57
	18	1.57	
	17	1.50	
30%	10	0.67	0.67
	9	0.6	
	7	0.47	
40%	21	1.42	1.69
	18	1.69	
	17.5	1.55	

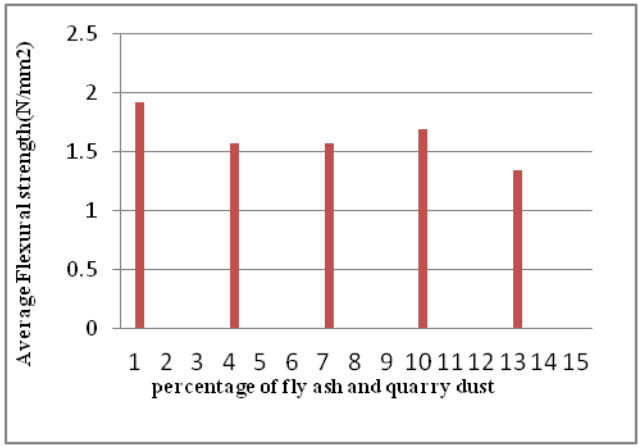

Figure 7: Result of 28 days

The value variation of flexural strength of cylinder for the partial replacement of Fine aggregate with fly ash and quarry dust increased values in the order of after 28 days 1.92, 1.57, 1.57, 0.67, 1.69 for 10%, 20%, 30% and 40% of fly ash and quarry dust proportions replacements respectively.

IV. CONCLUSION

The concrete was prepared for the M25 grade concrete with partial replacement of cement by fly ash and quarry dust with various percentages of 10%, 20%, 30% and 40%. The specimens were casted for 7days and 28 days then tested. The results are presented below.

From the above results following conclusion were made

1. The compressive strength for partial replacement cement with fly ash and quarry dust increased in the order of 35.06, 35.15, 36 for 10%, 20% and 30% partial replacements respectively.
2. The split tensile strength for partial replacement of cement with fly ash and quarry dust increased in the order of 2.75, 2.83, 3.01, 2.92 for 10%, 20%, 30% & 40% partial replacements respectively.
3. The flexural strength for partial replacement of fine aggregate by GGBS increased in the order of 1.92, 1.57, 1.57, 0.67, 1.69 for 10%, 20%, 30%, 40% & 50% partial replacements respectively and with respect to control specimen.
4. The maximum compressive strength, spilt tensile strength for partial replacement of cement with fly ash and quarry dust be achieved by 30% is found to be greater than the conventional concrete.
5. The maximum flexural strength for partial replacement of cement with fly ash and quarry dust be achieved by 50% is found to be greater than the conventional concrete.

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