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An Experimental Study on Fly Ash Blended Cement Concrete with Partial Replacement of Quarry Sand

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***Abstract*—** The M_{25} concrete with high volume fly ash and quarry sand replacement for fine aggregate are examined in the present study.The effect of the amount of fly ash was evaluated adapting 10%, 20%, 30%, 40% cement replacement. Quality is determined from the experimental test values. For the best proportion of fly ash, the quarry sand is partially replaced for fine aggregate in various percentages of 10%, 20%, 30%, 40%. The required specimen are cast to test the workability, mechanical, micro structural properties of the produced concretes of mix M_{25}.The various tests that are to be conducted to evaluate the behavior of high volume fly ash concrete are Compressive strength, Split tensile strength, Flexural strength and absorption.

***Keywords*—** fly ash, quarry sand.

I. INTRODUCTION

Concrete is a composite material which is made up of filler and a binder. Typical concrete is a mixture of fine aggregate, coarse aggregate, cement and water. Concrete has many properties that make it a popular construction material. The correct proportion of ingredients, placement and curing are needed in order for these properties to be optimal.1.3 billion tones of Portland cement is being produced annually, but here there is no way to stop the demand of more concrete. A solution is found to solve the above problem by utilizing the finely divided residue resulting from the combustion of powdered coal and transported by the flue gases and collected by electrostatic precipitator.In recent times, the importance and use of fly ash in concrete has grown so much that it has almost become a common ingredient in concrete. There are many advantages of using fly ash in concrete, particularly compressive strength of concrete after 28 days is more than the normal concrete. The durability of concrete is also increased by using fly ash.The strength micro structural properties and durability are increased by using fly ash in concrete and it leads to the extent of studying the actual behavior of the reinforced concrete beam. Deflection, crack due the load in the various combination of percentages of fly ash and quarry sand that influence the behavior of R.C. beam is a major area of study.

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II. MATERIALS AND METHODS

A. Cement

Ordinary portland Cement (OPC) conforming to IS: 8112 – 1989, having a specific gravity of 3.15 was made use of, in the casting of the specimens.

B. Fine Aggregate

The fine aggregate (sand) used was clean dry sand. The sand was sieved in 4.75mm Sieve to remove all pebbles.

C. Coarse Aggregate

Hard stones of size less than 20mm were used as coarse aggregate.

D. Fly Ash

It is fine,silt size consisting largely of spherical, hollow, glassy particles which are finer than cement.The fly ash samples were obtained from Mettur thermal power plant.

CHEMICAL COMPOSITION OF FLY ASH

The chemical composition in fly ash obtained from Mettur has

Silica - 54.92%.
Alumina - 23.04%,
Calcium oxide - 3.84%,
Magnesium Oxide - 2.82%,
Iron - 6.62%,
Phosphorous - 0.3%,
Alkali Metals Oxide- 2.7%,
Sulphur - 0.76%,
Magnesium - 2.82%,
Loss of Ignition - 2.88%.

Property	Quarry sand	River sand
Specific gravity	2.57	2.60
Bulk relative density(kg/m^2)	1765	1460
Absorption(%)	1.35	Nil
Moisture content((%)	Nil	1.50
Fine particles less than 0.075mm(%)	13.5	06
Sieve analysis	Zone II	Zone II

Physical properties of quarry sand and river sand

E. Quarry sand

Quarry sand is a powder form of waste obtained from quarry.The quarry sand obtained from a quarry at salem is used for this project.

III. HARDENED TEST ON CONCRETE

A. Compression Test

After 7 days,14 days and 28 days of curing, three 150mm cubes of a concrete mixture were tested using the compression machine. These cubes were loaded on their sides during compression testing such that the load was exerted perpendicularly to the direction of casting. The average value of the three cubes was taken as the compressive strength.

B. Split Tensile Test

The test was carried out by placing the cylindrical specimen horizontally between the loading surfaces of a compression testing machine and load is applied until the initial crack of the specimen occurs, along the diameter.

C. Flexural Strength

The test was carried out on 100mm X100mm X500mm size prism. The test was carried out on a universal testing machine of 400kN capacity, adopting two point loading. The bearing surfaces of the supporting and loading rollers are wiped clean, and any loose sand or other material removed from the surfaces of the specimen. The specimen was placed in the UTM and that the load was applied to the uppermost surface as cast in the mould, along two lines spaced 20cm apart. The load was increased until the specimen fails, and the maximum load applied to the specimen during the test was recorded and appearance of the fractured faces of concrete was noted.

IV. RESULTS

Table.1
Conventional Concrete

Compressive Strength(N/mm2)			Split tensile Strength (N/mm2)	Flexural Strength (N/mm2)
7 days	14 days	28 days		
14.53	29.26	38.33	1.86	3.8

Table .2

COMPRESSIVE STRENGTH(N/mm^2)-FLY ASH

S.NO	SPECIMEN	7 DAYS	14 DAYS	28 DAYS
1	C.S	14.53	29.26	38.33
2	F.A.10%	17.18	29.32	38.40
3	F.A.20%	22.44	31.36	39.22
4	**F.A.30%**	**26.95**	**34.75**	**40.44**
5	F.A.40%	20.14	28.73	32.73

Table. 3

COMPRESSIVE STRENGTH(N/mm^2)-FLY ASH& QUARRY SAND

S.NO	SPECIMEN	7 DAYS	14 DAYS	28 DAYS
1	C.S	14.53	29.26	38.33
2	F.A.30%&Q10%	19.47	30.67	38.91
3	F.A.30%&Q20%	23.69	34.40	40.18
4	**F.A.30%&Q30%**	**27.99**	**35.85**	**41.22**
5	F.A.30%&Q40%	21.03	29.92	30.33

Table.4

SPLIT TENSILE STRENGTH (N/mm^2)-FLY ASH

S.NO	SPECIMEN	7 DAYS	14 DAYS	28 DAYS
1	C.S	0.62	1.34	1.86
2	F.A.10%	0.64	1.45	1.89
3	F.A.20%	0.89	1.68	2.24
4	**F.A.30%**	**0.95**	**1.88**	**2.45**
5	F.A.40%	0.65	1.22	1.74

Table.5				
SPLIT TENSILE STRENGTH (N/mm2)-FLY ASH & QUARRY SAND				
S.NO	SPECIMEN	7 DAYS	14 DAYS	28 DAYS
1	C.S	0.62	1.34	1.86
2	F.A.30%&Q10%	1.04	1.68	2.42
3	F.A.30%&Q20%	1.02	1.58	2.34
4	**F.A.30%&Q30%**	**0.96**	**1.36**	**2.47**

Table.6				
FLEXURAL STRENGTH (N/mm^2)-FLY ASH				
S.NO	SPECIMEN	7 DAYS	14 DAYS	28 DAYS
1	C.S	2.65	3.16	3.82
2	F.A.10%	2.73	3.2	3.92
3	F.A.20%	2.98	3.35	4.22
4	**F.A.30%**	**3.07**	**3.40**	**4.30**
5	F.A.40%	2.6	2.82	3.65

Table.7				
FLEXURAL STRENGTH (N/mm^2)-FLY ASH & QUARRY SAND				
S.NO	SPECIMEN	7 DAYS	14 DAYS	28 DAYS
1	C.S	2.65	3.16	3.82
2	F.A.30%&Q10%	2.83	3.35	4.12
3	F.A.30%&Q20%	3.15	3.45	4.37
4	**F.A.30%&Q30%**	**3.34**	**3.58**	**4.42**
5	F.A.30%&Q40%	2.5	2.70	3.42

V. CONCLUSION

- Mix M_{25} can be effectively used in reinforced concrete structure for increased durability and economy.
- Workability of concrete decreased as percentage of flyash increase in cement.
- The specimen F.A 10%, F.A 20%, F.A 30%, F.A 40% are subjected to compressive strength, split tensile strength and Flexural strength results are tabulated.
- From test results it is observed that F.A 30% (30% cement replacement by fly ash) hold good strength.
- Further in this experimental study, this F.A 30% concrete is modified by partially replacing the fine aggregate, river sand with M-sand in various percentages such as 10%, 20%, 30%, 40%. From the test results, it is observed that 30% replacement of Quarry sand concrete gives strength in all the aspects.
- Thus, when compared to conventional concrete 30% replacement of cement with flyash and 30% replacement of river sand with Quarry sand has increase in compressive strength,split tensile strength and Flexural Strength.

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