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An Experimental Study On Effect Of Partial Replacement Of Cement By Flyash And Fine Aggregate By Stone Dust On Concrete

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Abstract - The primary aim of this project was to compare the strength properties of M25 grade concrete by partial replacement of cement with fly ash and fine aggregate with stone dust. This research has shown that replacing some percentage of cement with fly ash and fine aggregate with stone dust to reduce the cost of construction and avoid the scarcity of fine aggregate. Ingredients of concrete are cement, fine aggregate and coarse aggregate. Cement acts as a binding material which hold fine and coarse aggregate, Aggregate occupies 70-80% by volume and 70-85% by weight in concrete, where as fine aggregate doesn't impart on strength but increase the volume and reduce the cost of construction whereas coarse aggregate imparts on strength. In order to find the strength of concrete following tests are conducted i.e. destructive tests (compressive strength and split tensile strength) and non destructive tests (rebound hammer test).

Keywords-compressive strength, fly ash, rebound hammer, slump, split tensile strength, stone dust, workability.

I. INTRODUCTION

Concrete is the most widely used material on earth after water. Concrete is a composite material composed of granular materials like coarse aggregates embedded in a matrix and bound together with cement or binder which fills the space between the particles and glues them together. Concrete is unique among major construction materials because it is designed specifically for particular civil engineering projects. Almost three quarters of the volume of concrete is composed of aggregates. To meet the global demand of concrete in the

future, it is becoming a more challenging task to find suitable alternatives to natural aggregates for preparing concrete. Therefore the use of alternative sources for natural aggregates is becoming increasingly important. Most of the developing countries are under pressure to replace fine aggregate in concrete by an alternate material also to some extent or totally without compromising the quality of concrete. Quarry dust has been used for different activities in the construction industry, such as building materials, road development materials, aggregates, bricks, and tiles.

II. OBJECTIVES OF THE STUDY

The work reported in this study, fly ash obtained from NTPC Visakhapatnam, Andhra Pradesh is used as a cement replacement of material in concrete mix and stone dust obtained from stone crusher plant located in Tekkali, Srikakulam, Andhra Pradesh. Optimal dosage range of this fly ash and stone dust is chosen based on concrete mix studies. The ultimate focus of this work is to ascertain the performance of concrete mix containing fly ash and stone dust and compare it with the conventional concrete mix. This is expected to provide: -

1. To partially replace sand with fly ash and stone dust in concrete as it directly influences economy in construction.
2. To design and proportion the concrete mix for M25 grade concrete, as per the recommendation of IS: 10262:2009.
3. To find the fresh and hardened properties of concrete mixes by partially replacing of cement and fine aggregate with fly ash and stone dust respectively.
4. To check the variation of Compressive strength and Split Tensile Strength studies by partially replacing the cement by 35% and fine aggregate from 0% to 100% with fly ash and stone dust respectively and compares with conventional concrete mix and plotting the corresponding graphs separately.

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III. MATERIALS USED

CEMENT:

Ordinary Portland cement (OPC) of 53 grade (Priya cement) was used. Cement specific gravity is 3.12.

FLY ASH:

Size of particles of fly ash is 0.1µm to150µm. the fly ash was collected from NTPC Visakhapatnam.

STONE DUST:

Stone dust was obtained from stone crusher plant located in Tekkali, Srikakulam (A.P).specific gravity is the test done on stone dust.

PROPERTY	QUARRY DUST	NATURAL SAND	TEST METHOD
Specific gravity	2.54-2.6	2.43	IS 2386 (PART III)-1963
Bulk density (kg/m3)	1720-1810	1460	IS 2386 (PART III)-1963
Absorption(%)	1.20-1.50	2.6	IS 2386 (PART III)-1963
Moisture content(%)	Nil	1.50	IS 2386 (PART III)-1963
Sieve analysis	Zone-II	Zone-II	IS 383-1970

Table 3.1 Showing the physical properties of quarry dust and natural sand

IV. EXPERIMENTAL INVESTIGATION

The experimental investigation was planned to know the effect of addition of fly ash and stone dust as a partial replacement of cement(53grade) and fine aggregate (natural sand) respectively. The fine aggregate has been replaced accordingly in the range of 0% , 25% , 50% , 75% & 100% and the cement is replaced with 35% of fly ash by weight of M-25 grade concrete as per IS 10262-2009. Cubes of standard size 150mmx150mmx150mm were casted and tested for 7, 14 and 28 days for compressive strength. Standard cylinders of size 150mmx300mm were casted and tested for 7, 14 and 28 days split tensile strength and Thus replacing the fly ash and stone dust in concrete would lead to considerable environmental benefits and would be economical.

V. RESULTS AND DISCUSSIONS

Table No.5.1 Variation of slump w.r.t different proportions of fly ash and stone dust.

S.NO	Description	Slump(mm)
1	Plain concrete	33
2	F.A-25% S.D-25%	28
3	F.A-25% S.D-50%	22
4	F.A-25% S.D-75%	15
5	F.A-25% S.D-100%	10

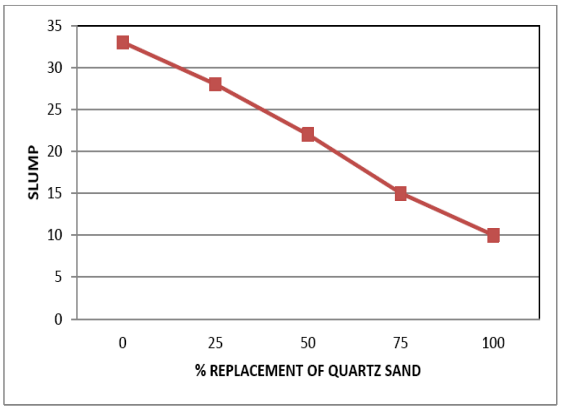

Figure No.5.1 Variation of slump w.r.t different proportions of fly ash and stone dust.

Table No.5.2 Variation of Compressive strength of concrete with different proportions of fly ash and stone dust w.r.t. age.

S.NO	% OF REPLACEMENT	7 DAYS (Mpa)	14 DAYS (Mpa)	28 DAYS (Mpa)
1	WITHOUT REPLACEMENT	29.44	30.26	31.02
2	FLY ASH-30% STONE DUST-25%	19.93	26.71	28.30
3	FLY ASH-30% STONE DUST-50%	29.53	31.08	37.43
4	FLY ASH-30% STONE DUST-75%	26.34	27.81	28.11
5	FLY ASH-30% STONE DUST-100%	23.77	24.48	33.65

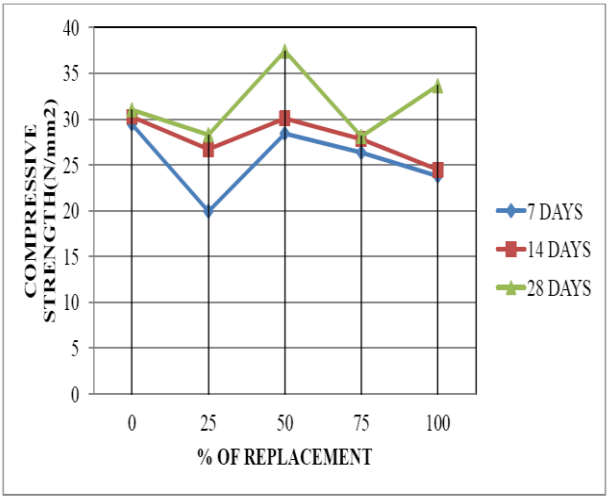

Figure No.5.2 Variation of Compressive strength of concrete with different proportions of fly ash and stone dust w.r.t. age.

Table No.5.3 Variation of split tensile strength of concrete with different proportions of fly ash and stone dust w.r.t. age.

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S.NO	% OF REPLACEMENT	7 DAYS (Mpa)	14 DAYS (Mpa)	28 DAYS (Mpa)
1	WITHOUT REPLACEMENT	11.72	11.96	12.56
2	FLY ASH-30% STONE DUST-25%	9.71	11.21	12.28
3	FLY ASH-30% STONE DUST-50%	12.10	12.91	14.37
4	FLY ASH-30% STONE DUST-75%	8.93	11.26	12.28
5	FLY ASH-30% STONE DUST-100%	7.97	10.35	13.87

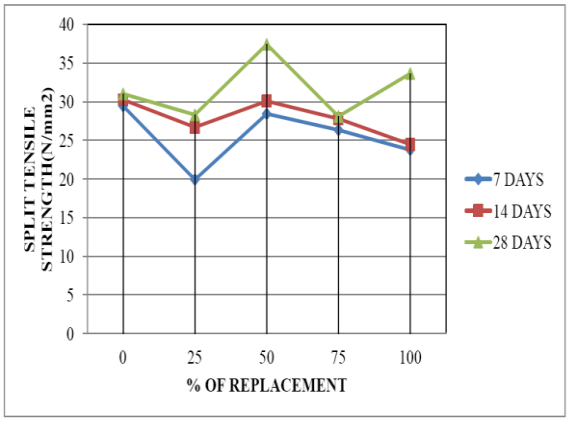

Figure No.5.3 Variation of split tensile strength of concrete with different proportions of fly ash and stone dust w.r.t. age.

Table No.5.4 Variation of compressive strength of concrete with different proportions of fly ash and stone dust w.r.t. age using Rebound Hammer.

	28 DAYS CUBE COMPRESSIVE STRENGTH (N/cm2)
WITHOUT REPLACEMENT	25
FLY ASH-30% STONE DUST-25%	22
FLY ASH-30% STONE DUST-50%	32
FLY ASH-30% STONE DUST-75%	22
FLY ASH-30% STONE DUST-100%	27

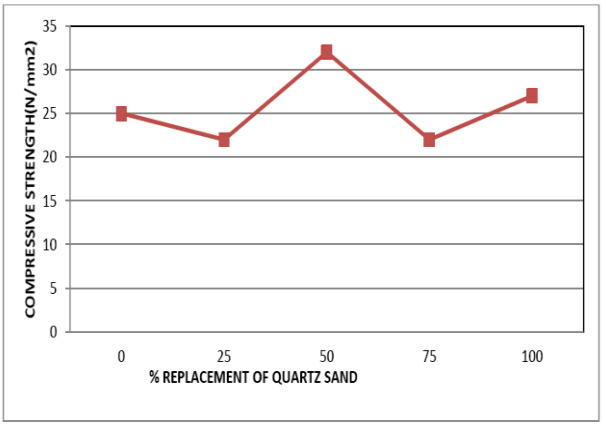

Figure No.5.4 Variation of compressive strength of concrete with different proportions of fly ash and stone dust w.r.t. age using Rebound Hammer.

VI. CONCLUSIONS

Based on the analysis of experimental results and discussions, the following conclusions are made:

1. The compressive strength, and split tensile strength of normal concrete and concrete replaced with Stone dust and fly ash partially are compared and observed that the strength of the normal concrete is slightly lower than the replaced concrete at 50% replacement.

2. The compressive strength increases at partial replacement of 25% fly ash and 50% stone dust by weight of cement and fine aggregate respectively.

3. The split tensile strength increases increases at partial replacement of 25% fly ash and 50% stone dust by weight of cement and fine aggregate respectively.

4. From the results of compressive strength, split tensile strength of 7, 14 and 28 days curing, 25% replacement of cement by fly ash and 50% replacement of fine aggregate is the optimum percentage of replacement of M25 grade concrete.

5. The following benefits can be obtained**:** -

(i)Cost reduction

(ii)Utilization of waste material is possible in construction by using Stone dust and fly ash as a partial replacement material for fine aggregate and cement respectively in concrete.

VII. FURTHER SUGGESTIONS

1. A much more extensive field study on a concrete structure made with fly ash and stone dust used in the mixture should be conducted and changes in durability and mechanical properties should be investigated and correlated to laboratory results.
2. Concrete made with different zones of fine aggregate can be carried out.

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3. Comparison of strength characteristics can be done by considering different grades of concrete.
4. Flexural strength tests.

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