"Study compressive strength characteristics of concrete by partially replacing of OPC cement by Fly Ash with grade M35 along with partial replacement of Natural sand by varying percentage of Crusher Dust and Waste Marble Dust"

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Abstract - ***The present paper deals with the effect on strength characteristics of cement concrete by using Fly ash (FA), Marble dust (MD) & Stone dust (SD). The study consist of II phases.1st phase 5%-35% of fly ash is used as partial replacement of cement, In II phase 5%-15% natural sand is replaced by MD and SD in different proportion in concrete. In phase II FA, SD & MD are combined from 5%-15% at an interval of 2.5%.Properties of fresh concrete and hardened concrete are investigated. Concrete prepared by partially replacing 20% of cement by Fly ash in 1st phase, Fly ash along with 10%stone dust &10% marble dust in 2nd phase showed good results. The 7day & 28 days compressive strength, shown good result than the control mix concrete.***

Key Words: M-35 Concrete, Waste Marble Dust, Fly Ash, Stone Dust, Workability, Compressive Strength.

1.INTRODUCTION

Fly ash is a beneficial mineral admixture for concrete. It influences many properties of concrete in both fresh and hardened state. Fly ash is a beneficial mineral admixture for concrete. It influences many properties of concrete in both fresh and hardened state. Quarry dust is powder of waste left by crushing stones to obtain stone blast and course aggregate for concrete. Marble dust is inexpensive & having a good physical composition as well as chemical composition. Pleasant aesthetic view, Good workability, less quantity of water cement ratio, Cost effective, easily available where marble industry situated, Economical, Good abrasion value & Resistance value against friction is good. Moreover, utilization of waste materials in cement and concrete industry reduces the environmental problems of power plants and decreases electricity generation costs.

1.1 Physical Properties of fly ash

Colour	Grey
Bulk Density (g/cm3)	1.28
Specific Gravity	2.16

1.2 Physical Properties of Quarry Rock Dust

Property	Quarry Dust	Test Method
Specific Gravity	2.54 – 2.60	IS 2386 (Part -III)-1963
Bulk Density	1710-1800	
Absorption (%)	1.20-1.50	
Moisture Content (%)	Nil	
Fine particles less than 0.075mm (%)	12-15	
Sieve Analysis	Zone-III	IS 383 (1970)
Fineness Modulas (%)	2.770	

1.3 Specific Gravity of Marble Slurry Particles

Material	specific gravity (OD)	specific gravity(SSD)	% Water Absorption
Coarse aggregate	2.407	2.434	1.131
Fine aggregate	2.733	2.632	1.729

2. LITERATURE SURVEY

(Kartikey, 2013)[1] As per the research work, He suggested that when the cement is partially replaced with fly ash, fly ash improves the properties of

structural concrete. In this work characteristic strength and properties of various grades of concrete were studied, the various grades were M15, M20 and M25 for all this grades fly ash was used with cement at 20%, 40% and 60%. When the cement is partially replaced with fly ash workability of concrete was increased with increased percentage of fly ash. For each grade of concrete three cubes were tested for compressive strength. The optimum strength was obtained for M15 grade was 14.48 N/mm2 for 20% replacement, 14 N/mm2 for M20 grade at 20% replacement level and 14.05 N/mm2 for M25 grade at 20% replacement. From this work finally concluded that fly ash replacement up to 20% shows greater strength than 40% and 60% for all three grades at 28 days of curing period.

(Pitroda,2013)[2] As per the research work, he suggested that, the cement has been replaced by fly ash accordingly in the range of 0% 10%, 20%, 30% & 40% by weight of cement for M-25 and M-40mix. Result was indicated that FA can be used as cement substitute at 10% replacement at 28 days curing age Compressive strength reduces when cement replaced fly ash. As fly ash percentage increases compressive strength and split strength decreases.

(Divakar,2012)[3] have experimented on the behavior of M20 grade concrete with the use of granite fines as a partial replacement for sand in 5%, 15%, 25%, 35% and 50%; and based on the results obtained for compressive, split-tensile and flexural tests, it was recommended that 35% of sand can be replaced by stone dust.

(Mahzuz, 2011)[4]have investigated on the use of stone powder in concrete as an alternative of sand using three concrete mix proportions, 1:1.5:3, 1:2:4 and 1:2.5:5. When the results of compressive strength were compared for these mixes between use of sand and stone powder, it was found that stone powder gives higher value than sand by about 14.76%, 4% and 10.44% respectively.

(**Ilangovan,2008**)[**5**] reported that the strength of quarry rock dust concrete was comparably 10-12% more than that of similar mix of conventional concrete.

(Gautam Bhadoriya,2015)[6] reported that water cement ratio increased with addition of fly ash than control mix. Initial and Final setting time of concrete are decrease with addition of fly ash. Using fly ash, marble dust and stone dust waste in concrete mix proved to be very useful to solve environmental problems and reduces to some extent the requirement of cement in large quantity. Therefore, it is recommended to re-use these wastes in concrete to move towards sustainable development in construction industry.

(HanifiBinici,2013)[7] reported that some mechanical properties concrete containing marble dusts (MD) and limestone dusts were investigated. Seven concrete mixtures were produced in three series with control mixes having 400kg cement content. These control mixes were modified to 5, 10 and 15% MD and LD in place of fine sand aggregate. The compressive strength of concrete was measured for 7, 28, 90 and 360 days.

(Priyanka A,2011.)[8] Reported that the effect of water cement ratio on hardened properties of cement mortar with partial replacement of natural sand by Marble Dust is investigated. Designed mortar mix having proportion as 1:2, 1:3 and 1:6 with water cement ratio of 0.5 and 0.55 respectively is used in experimental study. Mortar cube exhibits excellent strength with 50% replacement of natural sand by manufactured sand.

3. MATERIALS

Ordinary Portland Cement (OPC) of 43 Grade Birla Cement from a single lot was used throughout the course of the investigation**.**

Fly ash used was obtained from Kota thermal power station, Kota (Raj) India. Fly ash is one of the residues generated in the combustion of coal. Specific gravity of fly ash is 2.16, Fineness - 18% retained on 90µ sieve

Stone Dust used was obtained from stone crusher plant located in Gunwata (Raj). The water absorption and specific gravity are 0.73% and 2.72 respectively.

Marble Dust used was obtained from processing plant located at Kishangarh (Raj). And It is obtained by sawing and polishing of marble blocks. Specific gravity is 2.67 & Water absorption is 1.7%.

Natural Sand used Specific gravity =2.82, Water absorbed=0.77% ,Sieve analysis = III zone

Aggregate (20mm) used Specific gravity = 2.67 ,Water absorbed = 0.47%

Aggregate (10mm) used Specific gravity = 2.67 ,Water absorbed = 0.28%

Specific gravity of cement	3.15
Specific gravity of coarse aggregates (20mm)	2.67
Specific gravity of coarse aggregates (10mm)	2.67
Specific gravity of fine aggregates (Sand)	2.82
Zone of fine aggregates	III
Water absorption of coarse aggregates (20mm)	0.47%
Water absorption of coarse aggregates (10mm)	0.28%
Water absorption of fine aggregates (Sand)	0.77%
Specific Gravity of Fly Ash	2.16
Specific gravity of Admixture	1.12
Specific gravity of Quarry Rock Dust	2.72
Specific gravity of Marble Dust	2.67
Water Absorption of Quarry Rock Dust	0.73%
Water absorption of Marble Dust	1.7%

4. Experimental Investigation

The given materials when mixed in proportion (by weight) of **1 Cement: 1.765 Fine Aggregate: 2.97 Coarse Aggregate with a W/C Ratio of 0.425** will be able to produce a concrete of desired characteristic compressive strength of 43.25 **N/mm² (M-35)** required in field after 28 days within the design stipulations.

The experimental investigation was planned to know the effect of fly ash and marble dust, stone dust Addition as a replacement of Ordinary Portland cement (43 grade) and fine aggregate (natural sand).concrete sample were prepared using 150x150x150 mm cube mould for compressive strength, 150x150x700 mm beam mould for Flexure strength & 150X300 mm dia cylindrical mould for M30 & M35 grade of concrete mix was designed as per IS 10262:2009.

Control Mix:

Water	Cement	FA	CA	Grade of Conc.
170	400	706	1189	M-35

Details of Mix: M-35 Grade (Fly Ash)

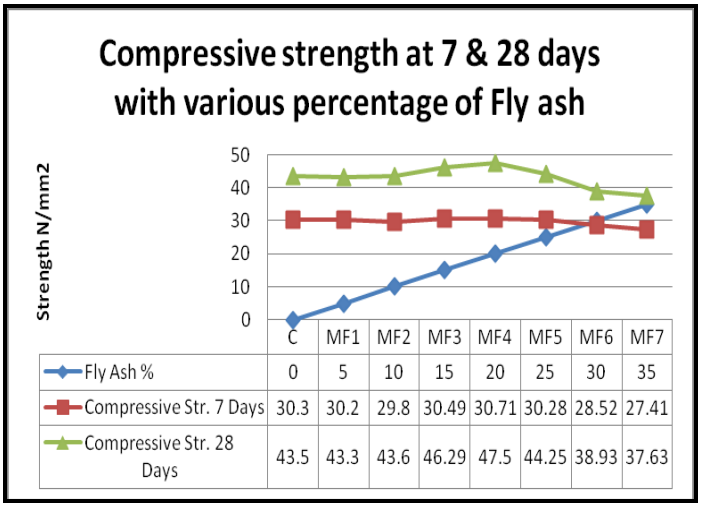
Mix	Cement	Fly Ash	Fine Aggregate			CA	W/C
			Sand	SD	MD		
C	100	0	100	0	0	100	0.43
MF1	95	5	100	0	0	100	0.43
MF2	90	10	100	0	0	100	0.43
MF3	85	15	100	0	0	100	0.43
MF4	80	20	100	0	0	100	0.43
MF5	75	25	100	0	0	100	0.43
MF6	70	30	100	0	0	100	0.43
MF7	65	35	100	0	0	100	0.43

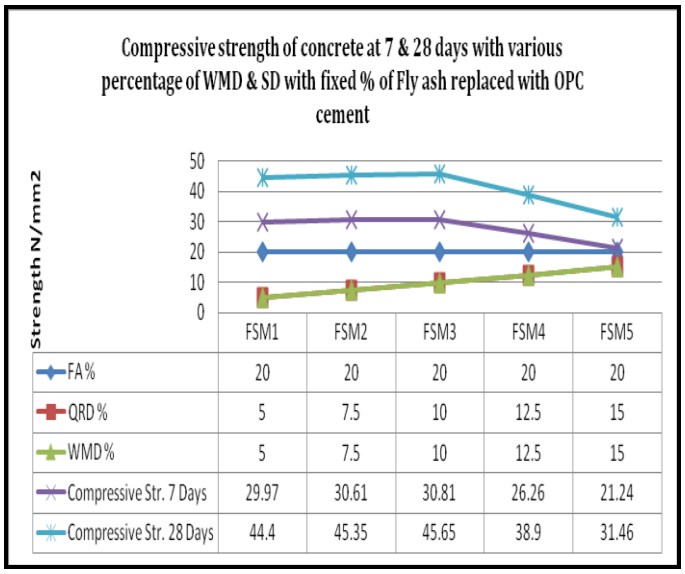
Detail of Mix combined with Fly Ash, WMD & SD

Mix	Cement	Fly Ash	Fine Aggregate			CA	W/C
			Sand	SD	MD		
FSM1	80	20	90	5	5	100	0.43
FSM2	80	20	85	7.5	7.5	100	0.43
FSM3	80	20	80	10	10	100	0.43
FSM4	80	20	75	12.5	12.5	100	0.43
FSM5	80	20	70	15	15	100	0.43

Detail of Sample Strength: M-35 Grade

MIX	Compressive Str.		MIX	Compressive Str.	
	7 Days	28 Days		7 Days	28 Days
C	30.3	43.5	FSM1	29.97	44.4
MF1	30.2	43.3	FSM2	30.61	45.35
MF2	29.8	43.6	FSM3	30.81	45.65
MF3	30.49	46.29	FSM4	26.26	38.9
MF4	30.71	47.5	FSM5	21.24	31.46
MF5	30.28	44.25			
MF6	28.52	38.93			
MF7	27.41	37.63			





5. CONCLUSION

- For M-35 grade of concrete 20% replacement of opc cement by fly ash gives good result.
- For M-35 grade of concrete with 10% replacement of sand by crusher stone dust along with 20% replacement of opc cement by fly ash gives satisfactory result.
- For M-35 grade of concrete with 10% replacement of sand by waste marble dust along with 20% replacement of opc cement by fly ash gives satisfactory result.

6. COST ANALYSIS OF CONTROL MIX

DESCRIPTION	Price (Per Kg)	Control Mix	Total Price
Fly Ash (Kg)	1.6	0	0
Cement (kg)	5	400	2000
Admixture (Kg)	50	8	400
20mm (Kg)	0.38	592.85	225.283
10mm(Kg)	0.38	592.85	225.283
Sand (Kg)	0.7	704.42	493.094

COST ANALYSIS OF FLY ASH DESIGN MIX

DESCRIPTION	Price (Per Kg)	Fly Ash Design Mix	Total Price
Fly Ash (Kg)	1.6	80	128
Cement (kg)	5	320	1600
Admixture (Kg)	50	8.8	440
20mm (Kg)	0.38	582.29	221.2702
10mm(Kg)	0.38	582.29	221.2702
Sand (Kg)	0.7	691.88	484.316

COST ANALYSIS OF FA + SD +WMD DESIGN MIX

DESCRIPTION	Price (Per Kg)	Fly Ash+SD+WMD Design Mix	Total Price
Fly Ash (Kg)	1.6	80	128
Cement (kg)	5	320	1600
Admixture (Kg)	50	8.4	420
20mm (Kg)	0.38	601.39	228.5282
10mm(Kg)	0.38	601.39	228.5282
Sand (Kg)	0.7	571.66	400.162
Stone Dust(Kg)	0.09	68.92	6.2028
Waste Marble Dust (Kg)	0.05	67.66	3.383

S/N	Description	Total Cost	Remarks
1	CONTROL MIX	3343.00	
2	FLY ASH DESIGN MIX	3095.00	7.44 % Reduction than control mix
3	FA + WMD + SD MIX	3015.00	9.83% Reduction than control mix

- Fly Ash Design mix is economical than control mix. Percentage of reduction than control mix is 7.44%.
- Combination of Fly Ash, Waste Marble Dust & Stone crusher dust is more economical than control mix as well as Fly Ash design mix. Percentage reduction in cost is 9.83%.

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BIOGRAPHIES

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