Comparative Study on strength between Fly Ash based and Normal Concrete in M20, M30 and M40 grades of concrete

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Abstract - *Concrete is the most widely used construction material in the modern world. Concrete incorporates a large amount of natural resources as aggregates and cement with water. Nowadays, the heat of hydration from concrete structures is the major environmental effect. Cement production also consumes huge energy and natural resources and causes about 7% of total greenhouse gas emissions in the world. The main objective of this investigation is comparative study on strength between Fly Ash based concrete and Normal Concrete in M20,M30 and M40 grades of concrete. Here in this study the fly ash is fixed to 30% replacement of cement. By using Fly ash the strength property is increased when compared with the normal concrete and also this research was focused on rebound hammer test and ultra sonic pulse velocity test*

Key Words: **Compressive strength,M20,M30,M40 grades of concrete,UPV Test, Rebound Hammer test**

1. INTRODUCTION

It is well realized that the development of Portland concrete consumes significant energy and simultaneously contributes a huge volume of CO2 to the environment. The environmental change because of an Earth-wide temperature boost has turned into a significant concern. The an Earth-wide temperature boost is brought about by the emanation of ozone depleting substances, like carbon dioxide (CO2), to the climate by human exercises. The concrete business is considered answerable for a portion of the CO2 discharges, in light of the fact that the creation of one ton of Portland concrete transmits roughly one ton of CO2 into the air. Nonetheless, Portland concrete is as yet the fundamental fastener in substantial development provoking a quest for additional harmless to the ecosystem materials. A few endeavors are underway to enhance the utilization of Portland concrete in concrete to resolve the an unnatural weather change issues. These incorporate the use of beneficial establishing materials, for example, fly debris, silica rage, granulated impact heater slag, rice-husk debris and metakaolin, and the improvement of elective folios to Portland concrete.

One potential option is the utilization of antacid enacted fastener utilizing modern side-effects containing silicate materials. In 1978, Davidovits (1999) suggested that fasteners could be created by a polymeric response of basic fluids with the silicon and the aluminum in source materials of topographical beginning or result materials, for example, fly debris, GGBS and rice husk debris. He named these folios as geopolymers. The most well-known modern results utilized as folio materials are fly debris (FA) and ground granulated impact heater slag (GGBS). The intensity delivered by concrete during substantial relieving is called intensity of hydration. This exothermic response happens when water and concrete respond. How much intensity created during the response is generally connected with the sythesis and fineness of the concrete. Substantial temperature checking is basic to guarantee the drawn out strength and steadiness of substantial designs.

2. LITERATURE REVIEW

Rama Mohan Rao [2010] :- In this examination the consideration of fly debris in glass fiber built up concrete decreases the ecological contamination and works on the usefulness and solidness properties of cement. In the trial examination glass strands in various volume parts with 25% and 40% substitution of concrete by fly debris has been utilized to concentrate on the impact on compressive strength, split elasticity, flexural strength of cement. The expansion of strands in the plain substantial will control the breaking due shrinkage and furthermore decrease the draining of water.

P. R. Wankhede [2014] :- In this paper examination Effect of Fly Ash and Properties of Concrete the impact of fly debris. Extreme compressive strength of cement continues diminishing with expansion in w/c proportion of cement. Droop loss of cement continues expanding with increment of amount of fly debris. Concrete with 20% and 30% supplanting of concrete with fly debris shows great compressive strength for 28 days than typical cement for 0.35 w/c proportion.

3. MATERIALS AND METHODOLOGY

3.1 Fine aggregates:

Fine total is the fundamental fixing in substantial that comprises of regular sand or squashed stone. The quality and fine total thickness unequivocally impact the solidified properties of the substantial. The substantial or mortar combination can be made more solid, more grounded and less expensive assuming you made the choice of fine total on premise of reviewing zone, molecule shape and surface, scraped area and slide obstruction and ingestion and surface dampness.

Table 3.1. Sieve analysis of fine aggregate

Sieve No.	Cumulative percent passing	
	Fine aggregate	IS: 383-1970 – Zone II requirement
3/8" (10mm)	100	100
No.4 (4.75mm)	98.6	90-100
No.8 (2.36mm)	95.8	75-100
No.16 (1.18mm)	71.6	55-90
No.30 (600μm)	49.2	35-59
No.50 (300μm)	15.2	8-30
No.100 (150μm)	2.0	0-10

3.2 Cement:

A concrete is a cover, a substance utilized for development that sets, solidifies, and sticks to different materials to tie them together. Concrete is rarely utilized all alone, but instead to tie sand and rock (total) together. Concrete blended in with fine total produces mortar for brick work, or with sand and rock, produces concrete. Concrete is the most generally involved material in presence and is behind just water as the planet's most-polished off asset.

Concretes utilized in development are typically inorganic, frequently lime or calcium silicate based, which can be described as non-pressure driven or water powered separately, contingent upon the capacity of the concrete to set within the sight of water (see water powered and non-pressure driven lime mortar).

Table 3.2. Physical Properties of cement

Characteristics	Test Results	Values as per BIS:12269 - 2013
Grade	53	53
Fineness	6.5%	< 10%
Specific gravity	3.12	3.15
Standard consistency	32%	30% - 35%
Initial setting Time	50 min	>30 min
Final setting Time	450 min	< 600 min
Soundness	1.2 mm	< 10 mm

3.3 Fly Ash

According to ASTM C 618 (2003), Class F fly ash produced from Rayalaseema Thermal Power Plant (RTPP), Muddanur, A.P was used. The chemical and physical properties are presented in the Table 3.3

Table 3.3 chemical and physical properties

Particulars	Class F fly ash	ASTM C 618 Class F fly ash
Chemical composition		
% Silica(SiO_2)	65.6	
% Alumina(Al_2O_3)	28.0	
% Iron Oxide(Fe_2O_3)	3.0	SiO_2+ Al_2O_3+ Fe_2O_3>70
% Lime(CaO)	1.0	
% Magnesia(MgO)	1.0	
% Titanium Oxide (TiO_2)	0.5	
% Sulphur Trioxide (SO_3)	0.2	Max. 5.0
Loss on Ignition	0.29	Max. 6.0
Physical properties		
Specific gravity	2.12	
Fineness (m^2/Kg)	360	Min.225 m^2/kg

3.4 Methodology:

- Concrete cubes of M20,M30 and M40 grade based concrete and is being casted.
- Moulds have been removed and allowed for curing after 24 hours of casting.
- UPV and compressive strength will be evaluated for 7 days and 28 days after curing.

3.4.1 Compressive strength test

The compressive strength (f'c) of the specimen was calculated by dividing the maximum load applied to the specimen by the cross-sectional area of the specimen.

Fig 3.1 Compressive strength

3.4.2 Ultrasonic pulse velocity test

The test involves determination of ultrasonic pulse velocity (UPV) through concrete as per procedure give in ASTM C 597-02.

Pulse velocity (m/s)	Concrete quality grading
Above 4500	Excellent
3500-4500	Good
3000-3500	Medium
Less than 3000	Doubtful

Fig 3.2 Ultrasonic pulse velocity test setup

4. RESULTS AND DISCUSSIONS

The properties viz. compressive strength, ultrasonic pulse velocity and Rebound Hammer test were measured after 7 and 28 days of curing.

4.1 Strength results

Table 4.1 Compressive Strength ,Rebound Hammer number, Ultasonic pulse velocity Result

DAYS	TEST	NORMAL CONCRETE			FLYASH CONCRETE		
		M20 NORMAL CONCRETE	M30 NORMAL CONCRETE	M40 NORMAL CONCRETE	M 20 FLYASH CONCRETE	M30 FLY ASH CONCRETE	M40 FLY ASH CONCRETE
7-DAYS	COMPRESSIVE STRENGTH	18.62	21.97	25.22	17.73	24.4	26.77
	REBOUND HAMMER	32.1	34.44	35.88	28.1	21.66	23.55
	UPV	4510	4688	4545	4870	4886	4808
14-DAYS	COMPRESSIVE STRENGTH	22.62	24.22	37.33	24.21	30.45	37.22
	REBOUND HAMMER	37.99	39.21	38.1	27.44	20.66	27.88
	UPV	4808	4760	4870	5119	5034	4644
28-DAYS	COMPRESSIVE STRENGTH	30.75	39.26	50.12	31.23	40.66	51.26
	REBOUND HAMMER	35.1	31.66	35.33	26.3	24	27.3
	UPV	5102	5034	5017	5034	5017	5068

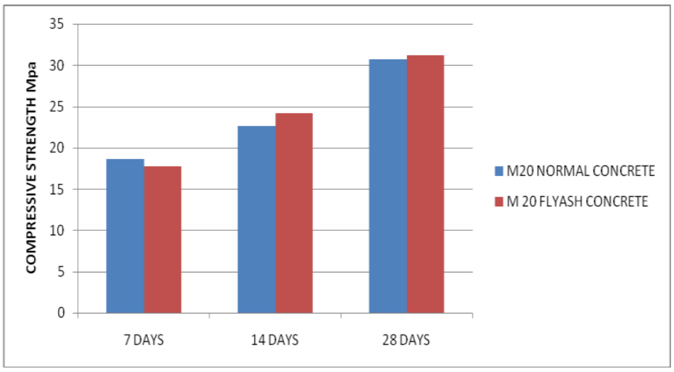

Fig 4.1 Comparison of compressive strength between normal concrete and fly ash concrete for M20 grade

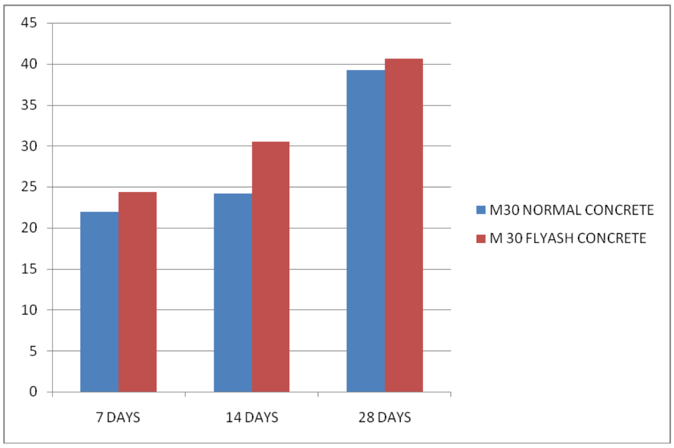

Fig 4.2 Comparison of compressive strength between normal concrete and fly ash concrete for M30 grade

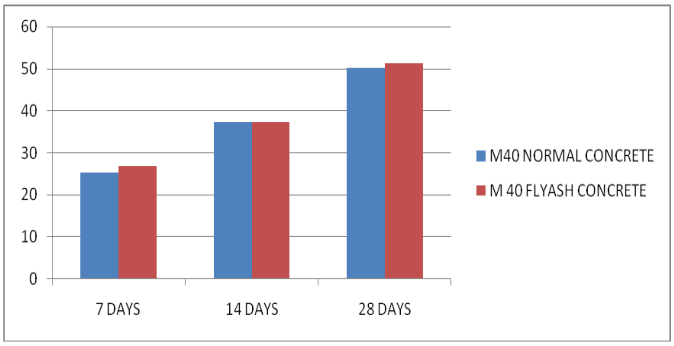

Fig 4.3 Comparison of compressive strength between normal concrete and fly ash concrete for M40 grade

Adding 30% of fly ash a mineral admixture increases the compressive strength results for all grades of concrete

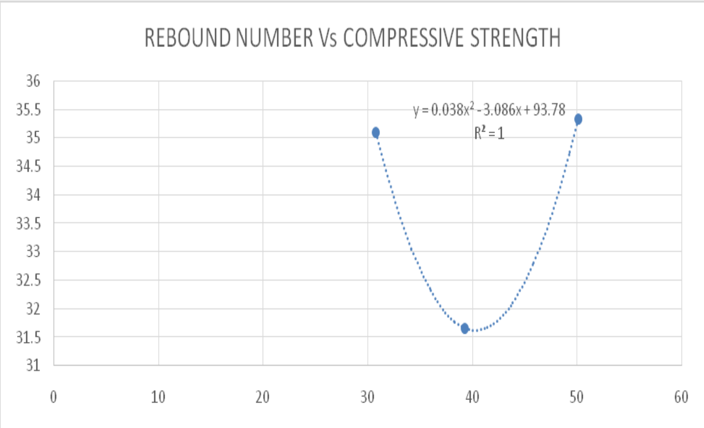

Fig 4.4 Correlation between compressive strength of normal concrete and Rebound number

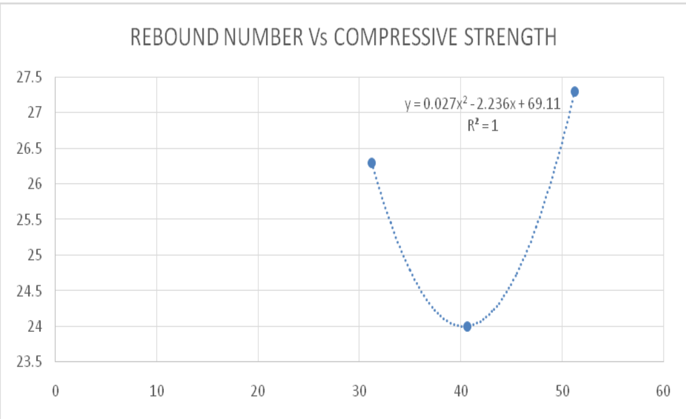

Fig 4.5 Correlation between compressive strength of Fly ash concrete and Rebound number

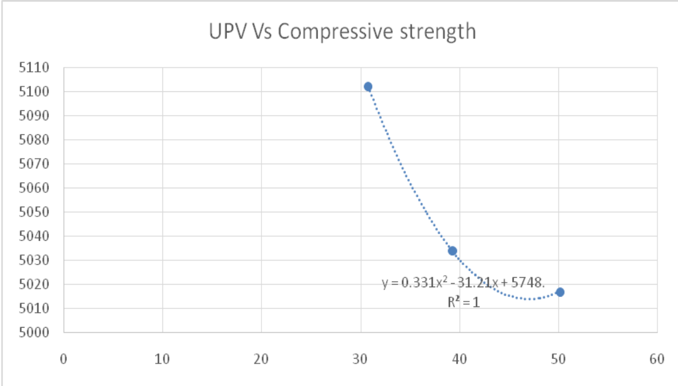

Fig 4.6 Correlation between compressive strength of normal concrete and UPV

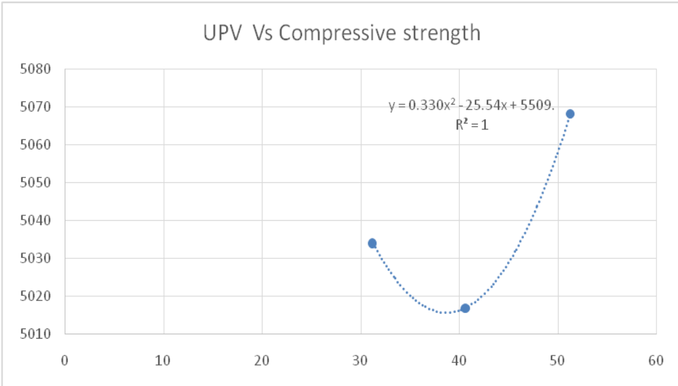

Fig 4.7 Correlation between compressive strength of Fly ash concrete and UPV

An attempt was made establish the relation between compressive strength (MPa) and Rebound hammer test and compressive strength with UPV.As it can be seen from fig's that there is direct correlation between compressive strength with UPV and Rebound hammer number. Polynomial regression analysis was performed and the result is shown in Figure. Correlation between compressive strength with Rebound hammer number and UPV showed R-squared value of 1. Following equations are proposed for predicting the compressive strength of concrete.

$$y = 0.038x^2 - 3.086x + 93.78$$

$$y = 0.027x^2 - 2.236x + 69.11$$

$$y = 0.331x^2 - 31.21x + 5748$$

$$y = 0.330x^2 - 25.54x + 5509$$

5.CONCLUSIONS

Based on the results of this experimental investigation, the following conclusions can be drawn:

- After Addition of Fly ash the compressive strength values are increasing with increasing grades of concrete.

- Fly ash is good admixture for increasing the compressive strength
- For all grades of concrete there is increased in strength of fly ash when compared with normal concrete.
- Good correlation was found between compressive strength With Rebound number and UPV.R-square value is equal to 1.

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