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The Effect of Fly Ash on the UPV of Fly Ash Blended Concrete with Age: An Experimental Investigation

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Abstract

To adapt to the supportability of concrete and modern development, it is sensible to utilize modern results like Fly Ash (FA) as one of the crude fixings utilized in Usual Strength Concrete. The motivation behind this study is to decide the capability of FA in typical strength concrete for modern applications. Regular waterway sand was utilized as the fine total in the review. “The Ultrasonic Pulse Velocities (UPV) were estimated at different times subsequent to relieving, going from 1 day to 90 days. The Fly Ash is utilized as fractional substitution of Cement at the reach differing from 10% to 35% by volume. The ultrasonic heartbeat speeds of Fly Ash based Normal Strength Concrete were lower for all blends at 1 day when contrasted with control blend concrete. Anyway as the period of substantial builds the ultrasonic heartbeat speeds were considerably improved for every one of the blends. Exact connections between strength, UPV and Dynamic Elastic Modulus were proposed.

Keywords*: Fly Ash, Compressive Strength, Ultra sonic Pulse Velocity and Dynamic Elastic Modulus*

I. Introduction

Different businesses produce a large number of strong waste things. The removal of these strong side-effects represents a danger to the climate and the existences of the individuals who live close by. With the present developing ecological worries and maintainability issues, it's a higher priority than at any other time to utilize strong side-effects. The best system to alleviate the difficulties related with strong garbage removal is to effectively utilized them. Strong side-effects as development materials have tremendous potential in the development business. Strong waste materials can be used as supplemental cementations materials or as a fine/coarse total substitution in cement or mortars, contingent upon their characteristics. In view of the exploration reports a few strong waste materials, for example, fly debris, silica smolder, grounded impact heater slag and so on have been placed being used in assembling of one or the other concrete or cement.

Fly Ash

Fly debris is a finely isolated squander side-effect delivered by the ignition of crushed coal in warm creating plant suspension powered heaters. Electrical or mechanical precipitators, for example, twister precipitators or pack houses, gather it. It's better than concrete and made up to a great extent of circular smooth particles with a complicated compound and mineralogical cosmetics.
During the burning of coal, the items shaped are fly debris, base debris and gases as well as fumes. Fly Ash is the fine piece of the debris which is entrained in the vent gases, while the base debris is the buildup comprising of coarser discrete or combined particles sufficiently weighty to exit the ignition zone (heater chamber) onto the lower part of the heater. See Fig.1.1 the fume and gases structure the volatilized part of the carbonaceous material which are somewhat released into the environment and incompletely consolidate onto the outer layer of the fly debris particles. Contamination control gadgets, for example, scrubbers utilizing limestone slurry or powder are utilized to catch the SO, satisfied of the pipe gases prior to being delivered into the environment, especially when high sulfur coals are scorched. It could be pointed that relying upon the kind of precipitator involved most of incombustible mineral present in coal, around 85 to 99.9 percent

is recovered as fly and base debris while the rest of released into the environment.

II. Literature Review

Stream sand from riverbeds has principally been utilized as a fine total in substantial development. Lately, the utilization of mineral admixtures in concrete, for example, fly debris and ground granulated impact heater slag (GGBS), has soar, and it has become one of the principal components of substantial cement [1-12]. The American Concrete Institute (ACI) characterizes roller compacted concrete (RCC) as the substantial compacted by roller compaction [24]. RCC is a solid and incredibly dry cement and has a consistency as that of wet granular material or wet soil.The use of RCC as paving material was developed from the use of soil cement as base material. The first utilization of RCC asphalt was in the development of Runway at Yakima, WA in 1942[25]. The fundamental benefit of RCC over regular substantial asphalt is the speed in development and cost reserve funds. RCC needs no formwork, dowels and no completing [26].Concrete Pavements expansion of dynamic mineral admixtures like fly debris has incredible logical importance. Fly Ash (FA) comprises of SiO2 and Al2O3, and has high likely action. The primary valuable and massive impacts of FA can be of three folds: Morphologic impact, pozzolanic impact, and Micro total impact. [49].

Research in India in regards to the use of Fly debris has shown that the nature of fly debris created at National nuclear energy Corporation (NTPC) plants is very great as for fineness, low un-consumed carbon, high pozzolanic movement and adjusts to the prerequisites of IS: 3812 - 2003-Pulverized Fuel Ash for use as Pozzolana in concrete, concrete mortar and cement. The fly debris produced at NTPC stations is great for use in the production of cement [50] Assessing the nature of cement utilized for clearing applications has become fundamental for control tasks during and after development. Substantial asphalt is acquiring significance due to various worthwhile. Fly Ash has turned into a fundamental mineral admixture for creating great asphalt quality concrete and the equivalent can be utilized in the plan and development of low volume rustic streets. Ultrasonic Pulse Velocity (UPV) is a non-disastrous strategy for testing of substantial quality, homogeneity and compressive strength of existing designs. This technique is likewise a helpful device in assessing dynamic modulus of versatility of cement [14, 15].

The Dynamic modulus of Elasticity (Ed) is a fundamental and significant variable while evaluating the quality and execution of primary cement [42, 43]. The UPV is a valuable boundary for assessment of static modulus of flexibility, dynamic modulus of versatility, static Poisson's proportion and dynamic Poisson's proportion [16]. Yıldırım, H., and Sengul, O [4] directed exploratory examination on the modulus of flexibility of cement. A sum of 60 blends are ready, in which the impacts of water/concrete proportion, most extreme size of the total, total sort, and fly debris content are examined. Modulus of flexibility of the cements was gotten other than compressive strength and ultrasound beat speeds of the substantial. A model is likewise proposed to foresee the unique modulus of cement. The anticipated model has close relationship with trial test results. Wen, S.Y., and Li, X.B (2015)

[17] directed trial concentrate on Young's Modulus of cement through P-Wave speed estimations. Two experimental conditions for acquiring static Young's Modulus and Dynamic Young' Modulus when dynamic Poisson proportion differs around 0.20. Qasrawi, H. Y.(2000) [18] proposed an exact condition among UPV and Cube Compressive strength of Concrete and its R2 esteem was viewed as 0.9562. Subramanian Kolluru, S.V., et al (2000) [19] was proposed a strategy for assessing the versatile material constants of a substantial example utilizing longitudinal reverberation frequencies utilizing Rayleigh-Ritz technique. A basic, exact and more dependable technique is produced for deciding unique versatile constants of cement. Yaman, I.O., et al. (2001) [20] researched the utilization of backhanded UPVs in Concrete pieces and tracked down comparability among immediate and circuitous UPVs. A huge end is drawn that the circuitous UPV is genuinely like direct UPV. Choudhari, N.K., et al (2002) [21] proposed a system to decide the versatile modulus of cement by Ultrasonic strategy. M.Conrad et al (2003) [22] researched pressure strain conduct and modulus of flexibility of cement from the ages of 6 hours to 365 days. The Young's Modulus for the early ages and matured low cementitious RCC can be an outstanding sort capability. Washer, G., et al (2004) [23] led broad exploration on Ultrasonic testing of Reactive powder concrete. Demirboga, R., et al(2004) [34] found a connection between ultrasonic speed and compressive strength of substantial utilizing different mineral admixtures, for example, Fly ash(high volume), Blast Furnace Slag and mix of FA in substitution of Portland Cement.

Compressive strength, UPV not entirely set in stone at 3,7,28 and 90 days relieving period. A remarkable connection between compressive strength and UPV was accounted for. Atici, U.(2011) [35] assessed the compressive strength of cement containing different measures of impact heater slag and fly debris through non-horrendous tests like bounce back hammer and ultrasonic heartbeat speed tests at various restoring ages of 1, 3,7,28, and 90 days. Two unique techniques like fake brain organization and multivariable relapse examination took on for assessment of substantial strength and reasoned that the utilization of a counterfeit brain network had more potential in foreseeing the compressive strength of cement than multivariable relapse examination. Trtnik, G., et al (2009) [36] proposed a mathematical model for anticipating the compressive strength of cement in view of Ultrasonic Pulse Velocity and some substantial blend qualities. Panzera, T. H., et al. (2011) [37] distributed a paper on Ultrasonic heartbeat speed assessment of cementitious materials and underlined the meaning of UPV as a significant non-damaging procedure and gives solid outcomes based on quick estimations. Turgut, P. (2004) proposed a connection between substantial strength and UPV. Hannachi, S., et al.(2012) [39] concentrated on the utilization of UPV and Rebound Hammer tests on the compressive strength of cement and proposed three conditions for bounce back hammer, UPV and consolidated techniques for anticipating the compressive strength of cement. From the above writing review it is seen that, numerous analysts concentrated on the connection between compressive strength in connection with UPV, however the connections among UPV and the Elastic and Mechanical properties of Fly Ash Concrete asphalt blends have not been investigated. Also the use of Manufactured sand on the strength and elastic modulus of Fly ash Roller compacted Concrete Pavement has not yet been investigated. Hence an experimental investigation has been planned to predict the quality and behaviour of RCC made with Fly Ash intended for lean concrete bases and cement concrete surface courses and similar applications. This research work was focused on the relationship between Elastic properties, Compressive strength properties and UPV.1.1

III. Experimental Programme

Materials

The constituent elements used to manufacture concrete can have a big impact on the concrete's qualities. The sections below explain the constituent materials used in the manufacture of both conventional concrete (CC) and Fly Ash (FA) based concrete with different amounts of Fly Ash substitution, such as 10% (F 10), 15% (F 15), 20% (F 20), 25% (F 25), 30% (F 30), and 35% (F 35). This section discusses the chemical and physical properties of the constituent materials.

Cement

Ordinary Portland Cement 53 grade was used corresponding to IS 12269 (1987). The chemical and physical properties of the cement as obtained by the manufacturer are presented” in the Table 3.1 and 3.2 respectively.

Table: 3.1 Chemical Composition of Ordinary Portland cement

Oxide	Common Name	Approx. Amount (%)
“CaO	Lime	60 – 67
SiO_2	Silica	17-25
Al_2O_3	Alumina	3 – 8
Fe_2O_3	Iron Oxide	0.5 - 6
MgO	Magnesia	0.1 - 4
Na_2O	Soda	0.2 – 1.3
K_2O	Potassa	
SO_3	Sulphuric Anhydride	1 – 3”

Table 3.2 Physical Properties of Ordinary Portland Cement

“Physical properties	Test result
Specific gravity	3.06
Fineness (m^2/Kg)	311.5
Normal consistency	30%
Initial setting time (min)	90
Final setting time (min)	220
Soundness Lechatelier Expansion (mm) Autoclave Expansion (%)	 0.8 0.01”

Fine Aggregate

“The sand for the experimental programmed was purchased locally (Indian Standard Specifications IS: 383-1970). The sand was sieved using a 4.75 mm sieve to remove any particles larger than that, then washed to remove the dust. To achieve sieve analysis, the aggregates were sieved through a set of sieves measuring 4.75 mm, 2.36 mm, l.l8 mm, 0.6 mm, 0.3 mm, 0.150 mm, 0.75 mm, and pan. Natural river sand was used as fine aggregate. The bulk specific gravity in oven dry condition and water absorption of the sand as per IS 2386 (Part III) 1963 were 2.62 and 1% respectively. The gradation of the sand was determined by sieve analysis as per IS: 383-1970. Fineness modulus of sand was 2.69”.

Table: 3.3 Sieve Analysis of Fine Aggregate

“Sieve No.	Cumulative Percent Passing	
	Fine Aggregate	Requirements as per IS 383 – 1970 (ZONE II)
10 mm	100	100
4.75 mm	98.8	90 – 100
2.36 mm	96.8	75 – 100
1.18 mm	70.8	55 – 90

0.600 mm	48.2	35 – 59
0.300 mm	14.4	8 – 30
0.150 mm	2.0	0 – 10”

Coarse Aggregate

“As coarse material, 20 mm crushed granite stones were employed. According to IS 2386 (Part III, 1963), the bulk specific gravity in oven dry condition and water absorption of the coarse aggregate 20 mm are 2.6 and 0.3 percent, respectively. The bulk density, impact strength, and crushing strength of 20 mm aggregate are respectively 1580 kg/m3, 17.9%, and 22.8 percent”.

Table 3.4 Sieve analysis of 20 mm coarse aggregate

“Sieve size	Cumulative percent passing	
	20 mm	
20 mm	100	20 mm
16 mm	56.17	16 mm
12.5 mm	22.32	12.5 mm
10 mm	5.29	10 mm
4.75 mm	0	4.75 mm”

Water

“Generally, water that is suitable for drinking is satisfactory for use in concrete. When it is suspected that water may contain sewage, mine water, or wastes from industrial plants or canneries, it should not be used in concrete unless tests indicate that it is satisfactory. Water from such sources should be avoided.

Fly Ash

Fly ash is a by-product produced from the combustion of coal in an electrical generation station. According to design and control of concrete mixtures. Fly ash is a natural pozzolana, which means that it is a siliceous or siliceous-and-aluminous material which chemically reacts with calcium hydroxide (CH) to form composites having cementitious properties”. The physical and chemical properties of fly ash shown in Table 3.5

Table 3.5 Physical and Chemical Properties of Fly Ash

“Physical Properties		
S. No	**Property**	**Value**
1	Specific Gravity	2.2
Chemical Properties		
1	Silica (Si O2)	57.00
2	Alumina (Al2 O3)	23.00
3	Ferric oxide (Fe2 O3)	8.32
4	Sulfur trioxide(So_3)	5.00
5	Moisture content	3.00
6	Titanium Oxide(Tio_2)	0.23
7	Loss on ignition	3.55”

“Test Methods

This section describes the test methods that are used for testing the hardened properties of concrete

Compressive Strength Test

Compressive strength test was conducted on the cubical specimens for all the mixes at different curing periods as per IS 516 (1991). Three cubical specimens of size 150 mm x 150 mm were cast and tested for each age and each mix. 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 of cubes

Pulse Velocity

"The methodology framed in ASTM C 597-02 is utilized to decide beat speed through concrete. The beat speed through concrete was estimated utilizing a battery-worked Portable Ultrasonic Non-horrendous Digital Indicating Tester. An electro acoustical transducer in touch with one face of the substantial example creates longitudinal pressure wave beats, which are gotten by one more transducer in touch with the contrary essence of the substantial example. Travel time is characterized as the time (T) it takes for a heartbeat to go through an example of length (L). The beat speed (V) is inferred by duplicating the example length (L) by the travel time (T) (T)". The beat speed of substantial blend was determined utilizing the normal of three examples. The contraption set for the test is displayed in Fig 3.4 and upsides of heartbeat speed for reviewing concrete according to BIS 13311-92 (Part-I) are given in Table 3.6.

Table 3.6 Concrete quality grading as per BIS 13311-92 (Part-I)

"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 of cubes

Mix Design Of M 30 Grade Conventional Concrete

The following Table is shows the Mix design of M 30 grade concrete with different replacement levels of Flyash as per BIS 10262 – 2019"

Table 3.7 Mix Proportions of CC or F 0, F 10, F 15, F 20, F 25, F 30 and F 35

“Mix Type	Cement Kg/m3	Fly Ash Kg/m3	Water l/m3	20mm kg/m3	Sand kg/m3
F 0	427	0	202	1133	606
F 10	384.3	29.23	202	1133	606
F 15	362.9	44.73	202	1133	606
F 20	341.6	59.64	202	1133	606
F 25	320.3	74.56	202	1133	606
F 30	298.9	89.47	202	1133	606
F 35	277.5	104.4	202	1133	606”

IV. Results and Discussion

The test detections remain given besides talked about into this section. “The test discoveries look at the presentation of customary cement (M 30) (CC or F0) with fly debris mixed concrete (F10, F15, F20, F25, F30, and F35) over a scope of relieving times (1, 3, 7, 14, 28 and 90 days). At different relieving terms, the solidified properties of CC and FC, like compressive strength, ultrasonic heartbeat speed (UPV), and dynamic modulus of, still up in the air. It was suggested that compressive strength, ultrasonic heartbeat speed, and dynamic modulus of versatility have experimental connections.

Compressive Strength: 'Table 4.1 shows the compressive strength upsides of cement with fractional substitution of Fly Ash. Compressive strength of Fly Ash mixed substantial examples was estimated at 1, 3, 7, 14, 28 and 90 days of restoring according to IS 516.

Ultrasonic Pulse Velocity Test: Table 4.2 shows the ultrasonic heartbeat speed upsides of cement with halfway substitution of Fly Ash. Ultrasonic heartbeat speed of Fly Ash mixed substantial examples was estimated at 1, 3, 7, 14, 28 and 90 days of restoring according to IS 13311 (Part 1).

Effect of Fly Ash on Upv Of Fly Ash Blended Concrete With Age: The trial movement of UPV of control blend and fly debris based concrete with the age was displayed in Fig 4.1 and Table 4.2 (a, b and c) for fly debris blends from F0 to F35. The ultrasonic heartbeat speed of fly debris blends expansions in with expansion in restoring age. Likewise the UPV of fly debris mixed blends was viewed as higher than the control blend (F0) for all substitutions up to 35% at all ages. The expansion in UPV from 1 day to 3 days is at more slow rate, yet past 3 days to 90 days the UPV increments quickly. This is expected to the pozzolanic responses of fly debris are delayed at introductory age and quicker at later ages”.

Table 4.1 Compressive strength of concrete

"Mix	Compressive Strength of Concrete (MPa)					
	1 day	3 days	7 days	14 days	28 days	90 days
F 0	10.02	20.54	24.44	31.93	37.79	45.2
F 10	8.67	16.61	31.52	39.44	44.61	48.37
F 15	7.76	16.12	33.11	41.23	46.02	49.66
F 20	7.33	14.60	34.58	44.37	46.86	50.87
F 25	6.00	13.98	36.76	47.91	48.12	51.91
F 30	6.31	13.46	35.23	44.44	45.41	50.11
F 35	5.63	12.90	35.06	41.33	43.32	49.34"

Table 4.2.a. Ultrasonic Pulse Velocity of concrete (1 day & 3 days)

"Mix	Ultrasonic Pulse Velocity (km/Sec)							
	1 day				3 days			
	F1	F2	F3	Avg	F1	F2	F3	Avg
F 0	3.93	4.01	4.12	4.02	4.22	4.39	4.42	4.34
F 10	4.16	4.28	4.31	4.25	4.28	4.47	4.49	4.41
F 15	4.17	4.48	4.58	4.41	4.32	4.55	4.58	4.48
F 20	3.92	4.4	4.31	4.21	4.41	4.57	4.59	4.52
F 25	3.72	4.2	4.14	4.02	4.47	4.66	4.71	4.61
F 30	4.17	4.29	4.35	4.27	4.43	4.59	4.61	4.54
F 35	3.69	4.22	4.12	4.01	4.29	4.46	4.49	4.41"

Table 4.2.b. Ultrasonic Pulse Velocity of concrete (7 days & 14 days)

"Mix	Ultrasonic Pulse Velocity (km/Sec)							
	7 days				14 days			
	F1	F2	F3	Avg	F1	F2	F3	Avg
F 0	4.4	4.52	4.61	4.51	4.69	4.72	4.72	4.71
F 10	4.58	4.63	4.63	4.61	4.82	4.84	4.85	4.84
F 15	4.68	4.82	4.83	4.78	5.00	5.03	5.02	5.02
F 20	4.79	4.82	4.83	4.81	5.13	5.15	5.16	5.15
F 25	4.89	4.9	4.93	4.91	5.21	5.24	5.25	5.23
F 30	4.8	4.82	4.83	4.82	5.02	5.03	5.04	5.03
F 35	4.77	4.78	4.78	4.78	4.91	4.92	4.92	4.92"

Table 4.2.c. Ultrasonic Pulse Velocity of concrete (28 days & 90 days)

"Mix	Ultrasonic Pulse Velocity (km/Sec)							
	28 days				90 days			
	F1	F2	F3	Avg	F1	F2	F3	Avg
F 0	4.87	4.89	4.9	4.89	5.14	5.16	5.16	5.15
F 10	5.02	5.04	5.04	5.03	5.23	5.25	5.25	5.24
F 15	5.17	5.18	5.19	5.18	5.31	5.33	5.33	5.32
F 20	5.25	5.27	5.27	5.26	5.38	5.4	5.4	5.39
F 25	5.32	5.34	5.34	5.33	5.41	5.43	5.43	5.42
F 30	5.12	5.14	5.14	5.13	5.18	5.2	5.21	5.20
F 35	5.02	5.04	5.04	5.03	5.12	5.14	5.14	5.13"

Table 4.3. Effect of Fly Ash on Quality of Concrete with Age

"Mix	Quality of Concrete Mixes for all replacements levels (from 0 to 35%)					
	1 day	3 days	7 days	14 days	28 days	90 days
F 0	G	G	E	E	E	E
F 10	G	G	E	E	E	E
F 15	G	G	E	E	E	E
F 20	G	E	E	E	E	E
F 25	G	E	E	E	E	E
F 30	G	E	E	E	E	E
F 35	G	G	E	E	E	E"

E = Excellent; G = Good

"The impact of fly debris on the nature of fly debris based combinations with relieving age for all blends was displayed in Table 4.3. The quality evaluation of control blend (G0) with age shows that is viewed as great at early ages of 1 and 3 days. Notwithstanding, as the time increments from 3 to 90 days, the nature of substantial changes from great to superb. Comparative pattern has been noticed for blends F10 to F35. Among the Fly Ash based blends from F0 to F35, F25 blend shows great to phenomenal quality and higher UPV values in examination with different blends. Thus 25% Fly Ash substitution has been considered as an ideal substitution level.

Relationship between Compressive Strength and UPV of Fly Ash Mixes:

From the literature review, it was concluded that there is no definite relationship was existing between UPV and Compressive strength of Fly Ash blended concrete. Hence a relationship between compressive strength of Fly Ash blended concrete and UPV has been developed.

Fig 4.1 (a, b, c, d, e, f & g) shows the relationship between compressive strength of fly ash mixtures (F0, F10, F15, F20, F25, F30 & F35)" besides UPV at all ages.

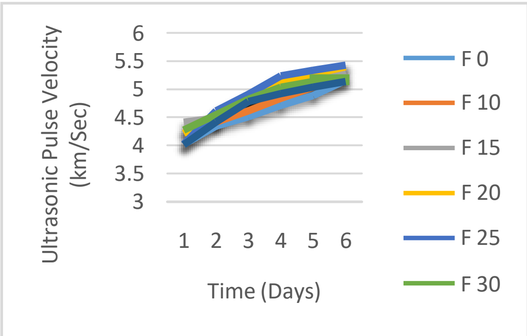

Fig 4.1. Progression of UPV with Time for FA mixes

From the experimental results, "exponential relationship between cube compressive strength and UPV has been proposed under:

y = 0.0636 e1.3017 (UPV), R2 = 0.9448 for control mix (F0)
y = 0.011 e1.6495 (UPV), R2 = 0.8464 for 10% FA (F10)
y = 0.0039 e1.8153 (UPV), R2 = 0.8464 for 15% FA (F15)
y = 0.0087 e1.6444 (UPV), R2 = 0.9284 for 20% FA (F20)
y = 0.0096 e1.6116 (UPV), R2 = 0.9548 for 25% FA (F25)
y = 0.0004 e2.2779 (UPV), R2 = 0.9515 for 30% FA (F30)
y = 0.0016 e2.0519 (UPV), R2 = 0.9802 for 35% FA (F35)

Where, y = Cube compressive strength in MPa
UPV = Ultrasonic Pulse Velocity in km/sec

The above equations were useful in predicting the compressive strength of fly ash based concrete for different conditions in terms of UPV at any age", and any dosage of Fly Ash.

Table 4.4. Effect of Fly Ash on Dynamic Modulus of Elasticity with Age

Dynamic Modulus of Elasticity (GPa)						
"Mix	1 day	3 days	7 days	14 days	28 days	90 days
F 0	35.63	41.60	44.85	48.92	52.65	58.56
F 10	39.83	42.95	46.93	51.58	55.86	60.62
F 15	42.88	44.32	50.31	55.49	59.17	62.49
F 20	39.08	45.12	51.09	58.41	61.08	64.14
F 25	35.63	46.93	53.09	60.39	62.72	64.85
F 30	40.20	45.52	51.16	55.79	58.10	59.55
F 35	35.46	42.95	50.31	53.30	55.86	58.10"

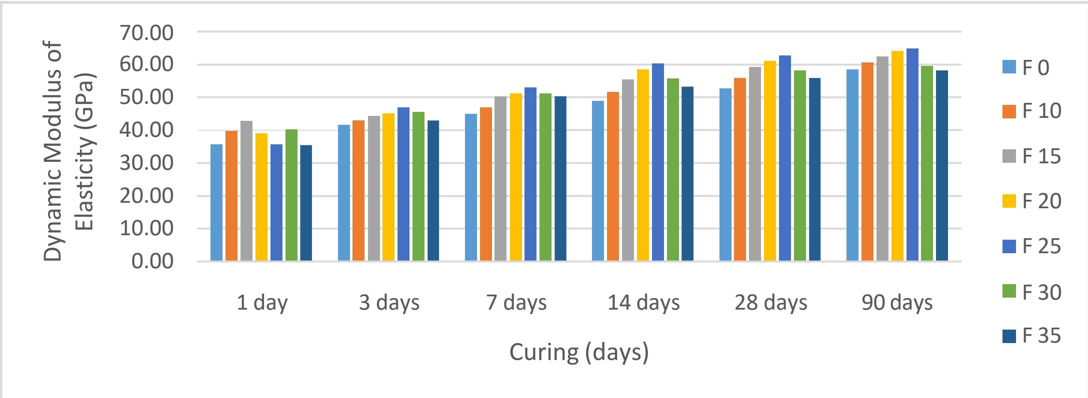

Fig 4.2. Progression of Dynamic Modulus of Elasticity with Time for FA mixes

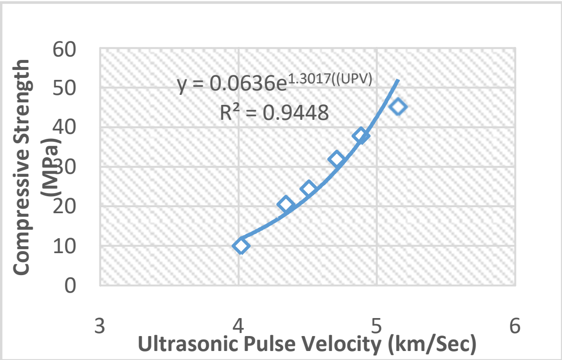

Fig 4.1.a. F0 Vs UPV

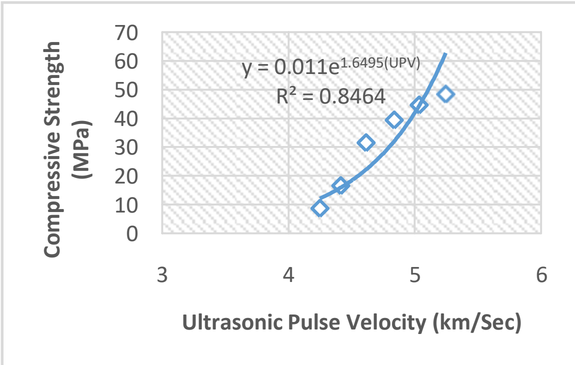

Fig 4.1.b. F10 Vs UPV

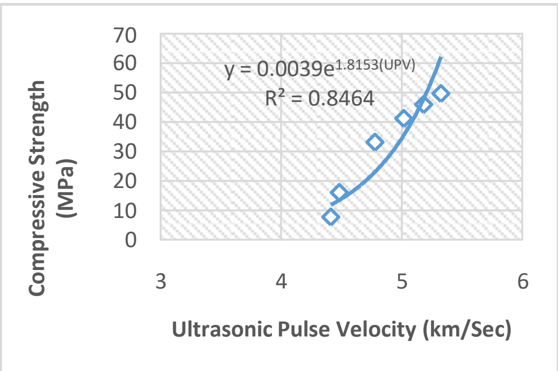

Fig 4.1.c. F15 Vs UPV

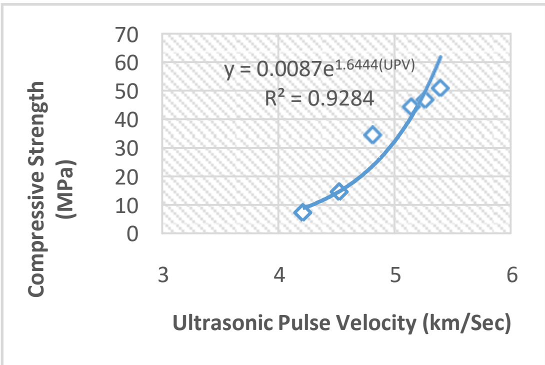

Fig 4.1.d. F20 Vs UPV

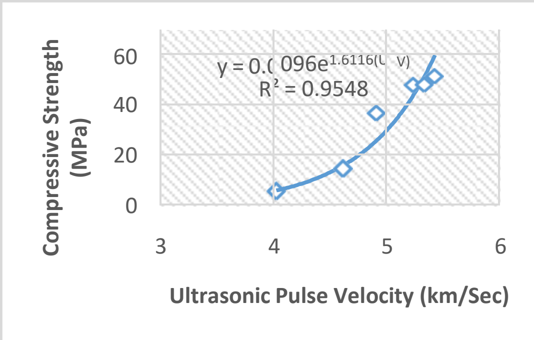

Fig 4.1.e. F25 Vs UPV

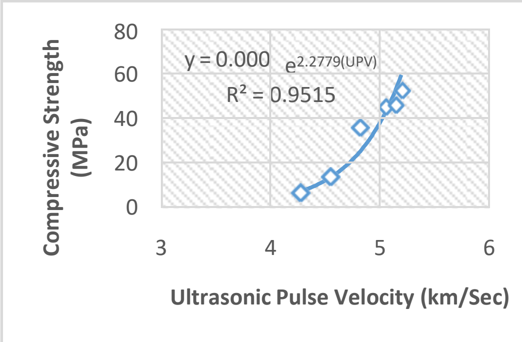

Fig 4.1.f. F30 Vs UPV

V. Conclusion

The UPV values are higher at 28 days and past 28 days for blends with 25% Fly Ash content.

1. "At the one day hydration, the nature of RCC with Fly Ash is viewed as really great for all blends. Nonetheless, from the ages of 3 to 90 days the quality was improved from great to fantastic because of the commitment of Pozzolanic responses of Fly Ah.
2. Use of UPV estimations is sufficient to assess the compressive strength and dynamic modulus of flexibility of Fly Ash based cements from various substitution levels of Fly Ash. Likewise a model was proposed for time subordinate unique modulus of versatility of Fly Ash based concrete.

VI. Future Scope

This work shall be extended to study the effect of other mineral admixtures like Silica Fume", Rice Husk Ashand Meta Kaolin etc.

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