

Effect of Fly Ash and Quarry Dust on Properties of Concrete

Shaik Irfan¹, M.Sri Priya²M.Tech. Student, Department of Structural Engineering, SVTM Engineering College, Madanapalle, A. P, India¹Assistant Professor, Department of Structural Engineering, SVTM Engineering College, Madanapalle, A. P, India²

ABSTRACT: The present work is an attempt to use Quarry Dust and Fly Ash as partial replacement for Sand and Cement respectively and to study the effect of them on the mechanical properties and quality assessment of concrete at different replacement levels. The experimental study has to be made to present the variation in the strength of concrete when replacing cement by fly ash with 0%, 10%, 20% and 30% by weight of cement and sand by quarry dust from 20%, 30% and 40% by weight of sand. The studies are to be made to ascertain the properties of M20 grade concrete by using fly ash as partial cement replacement and Quarry dust as partial fine aggregate replacement to determine the compressive strength experimentally at the curing age of 7, 14, 28, 56, 90 days at ambient room temperature and split tensile test and ultrasonic pulse velocity test at 28 days of curing period.

KEYWORDS: Fly ash, Quarry Dust.

I. INTRODUCTION

Fly ash is the one of the fine powder major waste material produced from many thermal power plants. the utilization of fly ash as a low cost mineral admixture in concrete instead of dumping it as a waste material can have great beneficial effects.



Fig: 1 Fly Ash

This quarry dust which is released directly into environment can cause environmental pollution. To reduce the impact of the quarry dust on environment and human beings, this waste can be used to produce new products or can be used as admixture in concrete so that the natural resources are used efficiently and hence environmental waste can be reduced.

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 8, Issue 12, December 2019



Fig 2. Sample of Quarry dust

II. LITERATURE REVIEW

Siva kumar and Prakash(2011) carried out works and stated that the 28 days compressive strength of 100% replacement of sand with quarry dust of mortar cube (CM 1:1) is higher than the controlled cement mortar cube. The 56 days maximum Compressive strength, split tensile strength and modulus of elasticity of concrete for 100% replacement of sand with quarry dust of 400 kg/m^3 , at fine to coarse aggregate ratio of 0.6, was higher than the reference concrete.

Balamurugan and Perumal (2013) studied the behaviour of concrete by replacing sand by quarry dust. They reported that the variation in the strength of concrete when replacing sand by quarry dust from 0% to 100% in steps of 10%. M_{20} and M_{25} grades of concrete are taken for their study keeping a constant slump of 60mm. From their test results it is found that the maximum compressive strength, split tensile strength and flexural strength are obtained only at 50% replacement. So, they concluded that quarry dust can be utilized in concrete mixtures as a good substitute for natural river sand at 50% replacement with additional strength than control concrete.

III. MATERIALS AND METHODOLOGY

FLYASH

In the present studies Fly ash (Class F Type) having specific gravity of 2.25 obtained from Rayalaseema Thermal Power Station which is located at Kadapa in Andhra Pradesh was used for the replacement of cement.

QUARRY DUST

Table 1. Properties of Quarry dust

Sl. No	Properties	Test Values
1.	Specific gravity	2.64
2.	Bulking of quarry dust	6%
3.	Fineness modulus	3.18
4.	Bulk density of quarry dust	1802 kg/m^3
5.	Water absorption	1.5%
6.	Particle size variation	0.15 to 4.75

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 8, Issue 12, December 2019

COMPRESSIVE STRENGTH TEST

Cubes with dimension of 150mm×150mm×150mm used for Compression test, durability test (acid). After 24 hours the specimens are removed from the moulds and immediately submerged in clean fresh water. After 3, 7, 28, 56 and 90 days the specimens are tested under the load in a compression testing machine.



Fig. 3. Testing of cube in compression testing machine

SPLIT TENSILE TEST

As per IS specifications IS 5816:1999 Split tensile test is to be conducted. The cylinder of size is 150 mm diameter and 300 mm length are taken and cylinders were placed horizontally between the loading plate surfaces of a compression testing machine.



Fig. 4. Split tensile test of cylinder

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 8, Issue 12, December 2019

ULTRASONIC PULSE VELOCITY TEST

Ultrasonic scanning is a recognized non-destructive evaluation test to qualitatively assess the homogeneity and integrity of concrete.



Fig. 5. Ultra Pulse Velocity Instrument

MODULUS OF ELASTICITY TEST

- measure of resistance
- slope of the stress-strain curve
- secant modulus
- $E = \text{stress} / \text{strain}$

$$= (F / A) / (dL / L)$$



Fig. 6. Compressometer Instrument

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 8, Issue 12, December 2019

IV. EXPERIMENTAL RESULTS

Designed mixes are recommended by “the bureau of Indian standards (BIS)(IS10262-1982)”. IS-10262-2009 .

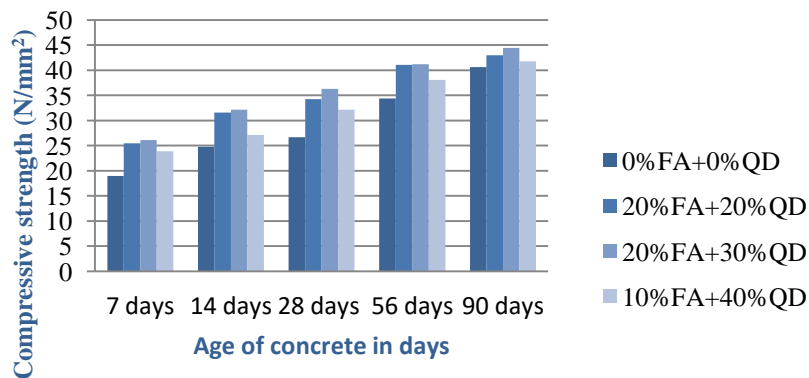
Cement = 320 kg/m³
Water = 175 lit/m³
Coarse aggregate = 1217.24 kg/m³
Fine aggregate = 727.48 kg/m³
Mix proportion 1: 1.27: 3.8: 0.55

COMPRESSIVE STRENGTH

Table 2. Compressive strength of different proportions of concrete cubes at different curing periods

Mix Proportions	Compressive Strength (N/mm ²)				
	7 Days	14 Days	28 Days	56 Days	90 Days
0%FA+0%QD	18.97	24.74	26.67	34.37	40.59
0%FA+20%QD	17.93	20.74	24.30	32.59	38.52
10%FA+20%QD	22.67	24.89	27.71	35.41	41.63
20%FA+20%QD	25.48	31.56	34.22	41.04	42.96
30%FA+20%QD	21.48	29.18	32.74	35.41	41.33
0%FA+30%QD	19.85	24.89	27.71	36.44	42.37
10%FA+30%QD	24.59	28.59	33.93	38.82	43.41
20%FA+30%QD	26.07	32.15	36.30	41.18	44.44
30%FA+30%QD	21.04	26.67	30.37	35.26	40.89
0%FA+40%QD	16.59	22.67	25.93	32.59	37.48
10%FA+40%QD	23.85	27.11	32.15	38.08	41.78
20%FA+40%QD	22.81	26.67	30.52	36.74	40.8
30%FA+40%QD	20.74	24.89	29.63	35.11	40.74

Compressive strength



International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

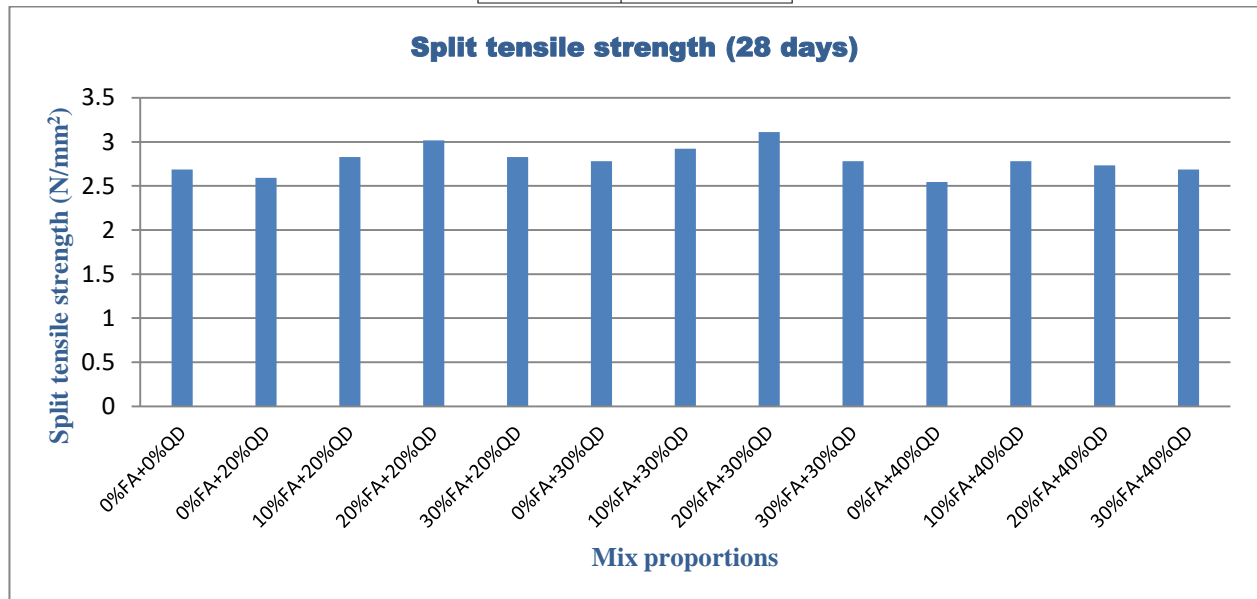
Visit: www.ijirset.com

Vol. 8, Issue 12, December 2019

SPLIT TENSILE STRENGTH

Table 3. Split tensile strength of different proportions of concrete cylinders 28 days of curing period

Mix Proportions	Split tensile Strength (N/mm ²)
	28 days
0%FA+0%QD	2.688
0%FA+20%QD	2.593
10%FA+20%QD	2.829
20%FA+20%QD	3.018
30%FA+20%QD	2.829
0%FA+30%QD	2.782
10%FA+30%QD	2.924
20%FA+30%QD	3.112
30%FA+30%QD	2.782
0%FA+40%QD	2.546
10%FA+40%QD	2.782
20%FA+40%QD	2.735
30%FA+40%QD	2.688



International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

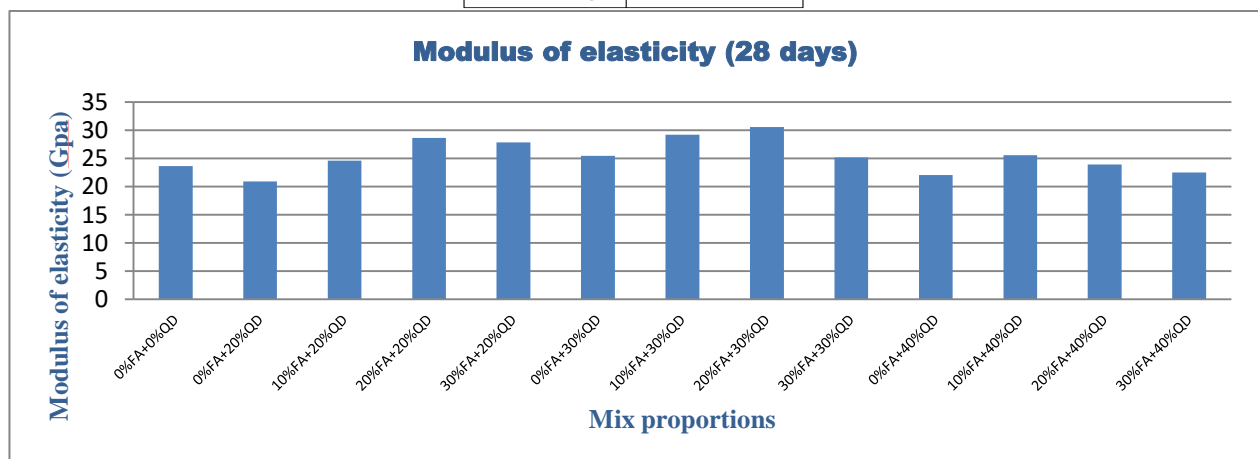
Visit: www.ijirset.com

Vol. 8, Issue 12, December 2019

MODULUS OF ELASTICITY –YOUNGS MODULUS

Table 4. Modulus of elasticity of different proportions of concrete cylinders at 28 days of curing period

Mix Proportions	Modulus of elasticity (GPa) 28 days
0%FA+0%QD	23.67
0%FA+20%QD	20.90
10%FA+20%QD	24.60
20%FA+20%QD	28.66
30%FA+20%QD	27.87
0%FA+30%QD	25.48
10%FA+30%QD	29.22
20%FA+30%QD	30.57
30%FA+30%QD	25.15
0%FA+40%QD	22.04
10%FA+40%QD	25.60
20%FA+40%QD	23.91
30%FA+40%QD	22.48



ULTRASONIC PULSE VELOCITY TEST

- In general, the ultrasonic pulse velocity values obtained for all the samples tested are in the range between 3.778 km/sec and 4.481 km/sec indicating that the quality of concrete is good.
- But for the mix proportion (20% fly ash and 30% quarry dust), the pulse velocity is 4.654 km/sec which is above 4.5 km/sec, indicating that the quality of concrete is excellent.

Table 5. Ultra sonic pulse velocity results

Mix Proportions	Pulse velocity (km/sec)	Quality of concrete
0%FA+0%QD	4.303	Good
0%FA+20%QD	3.778	Good
10%FA+20%QD	4.065	Good
20%FA+20%QD	4.455	Good
30%FA+20%QD	4.178	Good

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 8, Issue 12, December 2019

0%FA+30%QD	4.151	Good
10%FA+30%QD	4.481	Good
20%FA+30%QD	4.654	Excellent
30%FA+30%QD	4.032	Good
0%FA+40%QD	3.849	Good
10%FA+40%QD	4.327	Good
20%FA+40%QD	3.968	Good
30%FA+40%QD	3.829	Good

V. CONCLUSION

1. Fly ash consumes maximum water for consistency and workability.
2. Addition of fly ash to cement enhances the initial setting time whereas reduces the final setting time
3. In general, all the mixes attain the target strength and give more strength when compared to the controlled concrete irrespective of curing period.
4. All the mixes gain strength irrespective curing period.
5. The compressive strength, split tensile strength, modulus of elasticity and ultra sonic pulse velocity test specimens of concrete mix consisting of 20% fly ash and 30% quarry dust gives maximum values.
6. The partial replacement of cement with fly ash and fine aggregate with quarry dust in concrete not only enhances the strength of concrete, but also reduces the cost of production of concrete and at the same time, it also eliminates the environmental pollution and hazards caused due to the disposal of these waste by-products on land.

REFERENCES

1. Balamurugan .G and Dr. Perumal .P (2013), "Behaviour of concrete on the use of Quarry dust to replace sand – an Experimental study", IRACST – Engineering Science and Technology: An International Journal (ESTIJ),ISSN: 2250-3498, Vol. 3, No. 6, December 2013, pp.776-781.
2. Jayeshkumar Pitroda, Dr. Zala .L.B, Dr. Umrigar .F.S (2012), "Experimental investigations on partial Replacement of cement with fly ash in design mix concrete", International Journal of Advanced Engineering Technology, E-ISSN 0976-3945, IJAET/Vol.III/ Issue IV, October-December 2012, pp. 126-129.
3. Rama Raju .M.V, Vivek .K.V, Dr. Siva Shankar Reddy .T and Srinivas Reddy .P (2011), " Study of Properties of SCC using Quarry Dust and Fly Ash", International Journal of Engineering Sciences Research-IJESR, ISSN: 2230-8504; e-ISSN-2230-8512, Vol 02, Issue 04;August-September 2011, pp. 323-332.
4. Wankhede .P.R and Fulari .V.A (2014), "Effect of Fly ASH on Properties of Concrete", International Journal of Emerging Technology and Advanced Engineering, ISSN 2250 2459, ISO 9001:2008 Certified Journal, Volume 4, Issue 7, July 2014, pp. 284-289.
5. IS 10262:2009 Code for Concrete Mix Proportion, Bureau of Indian Standards, New Delhi, India.
6. IS 456-2000 Code of practice for plain and reinforced concrete structure, Bureau of Indian Standards, New Delhi, India.
7. IS 13311 (part 1):1992 Non -Destructive Testing of Concrete-Method of Test; Part 1- Ultrasonic Pulse Velocity, Bureau of Indian Standards, New Delhi, India.

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 8, Issue 12, December 2019

BIOGRAPHY



SHAIK IRFAN
M.Tech. Student,
Department of Structural Engineering,
SVTM Engineering College, Madanapalle
Jawaharlal Institute of Technology Anantapuramu



M.SRI PRIYA
Assistant Professor,
Department of Structural Engineering,
SVTM Engineering College, Madanapalle,
Jawaharlal Institute of Technology Anantapuramu