iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 8 **Issue:** X **Month of publication:** October 2020

DOI: https://doi.org/10.22214/ijraset.2020.31736

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue X Oct 2020- Available at www.ijraset.com

Study on the Effect of Partial Replacement of Fly Ash and Rice Husk on Concrete Pavement

Leena[1], Ajay Kumar Singh[2]
[1]MTech Scholar (Structural Engineering), SSTC, SSGI, BHILAI , C.G., India
[2]Assitant Professor, Department of Civil Engineering, SSTC, SSGI, BHILAI , C.G., India

Abstract: This research is to find environmental reuse of waste product also to find substitute of cement where these industries are located so that is nearby areas these products could not cause pollution, water logging and diseases to mankind. The study is analysis for the compressive strength of cement concrete when cement was replace with waste fly ash and waste rice husk ash in different ratio
Keywords: Pavement, Fly Ash, Rice Husk, Compressive strength, Tensile Strength.

I. INTRODUCTION

The use of concrete worldwide is second only to water. Ordinary Portland cement (OPC) is commonly used as a first-class bond for concrete production. A paved concrete floor is a structure consisting of a layer of Ordinary Portland Cement Concrete which is usually supported by a basement layer at a lower level. Portable tiles may be reinforced (plain) or reinforced depending on how the designer prefers to control the shrinkage cracking, which will occur on the roads. The advantages of concrete blocks are that they last longer - 40 years of Design Life, preserving natural resources. The cost of paving stone repairs is ten times cheaper than those of flexible corridors, can be built over the lower grades, the Greener process, Resistant abrasion from rotating actions. use of local building materials, Use of waste products such as fly-ash and slag, Concrete is generally not slippery in wet weather.
Concrete can be defined as a mixture of cement, sand, composite and water. It is widely used in human construction around the world. The popularity of concrete is due to the fact that common ingredients, concrete structures can meet the demand of any type of engineering project. Concrete can be spread in almost all conditions, which is why it is so popular and used in so many different types of construction. Several researchers have studied and reported the impact of using Fly Ash and Rice Husk Ash in Concrete, and few researchers have done it using FA, RHA and Super plasticizers. At present these materials are not widely used in the Indian construction industry. This study provides us with a conclusion on how Fly Ash and Rice Husk Ash can be used effectively and efficiently, especially in the equivalent of M30. Due to environmental concerns, energy saving requirements, various research efforts are focused on waste utilization. Airplane ash is one of the fossil fuels produced in coal-fired power plants. In addition, the production and use of concrete has a significant environmental impact due to the fact that Cement is a consumer of energy and CO2. Other factors and causes of CO2 emissions are such things as products that use high-temperature processes to produce materials such as cement, bricks; this is considered to be the main consumer of energy and greenhouse gases. Other emissions that can lead to CO2 emissions are lead, iron, and other chemical reactions such as ammonia and titanium dioxide that can have a negative impact on the environment. Rice ash is obtained by burning rice husk ash at temperatures between 5500 C to 7000 C, then the rice husk can form as a small cellular structure is produced. Rice husk ash has a rich silica content of non-crystalline (or) amorphous silica form. It shows that rice husk can be used as a cementitious additive due to its pozzolanic action.

II. LITERATURE REVIEW

NageshTatoba, Suryawanshi Samitinjay SBhansode et al [2012] studied on fly ash replacement for cement and sand to the extent of 10-30 percent and 5-15 percent for M35 grade of concrete respectively. Because of the use of fly ash, rigid pavement behaves as a semi rigid pavement causing substantial reduction in cost of construction. The study showed the usage of fly ash as a beneficial pavement material.
Vanitha Agarwal, Gupta S.M et.al [2012] experimented on high performance concrete with super plasticizer for M30, M40 and M50 grades of concrete with 30% and 40% fly ash replacements. The tests were conducted to analyze compressive and flexural strengths for 7,28 and 90 days, they concluded from their study that the all mixes with fly ash replacement showed better strengths when compared to design mix and at 30% addition they are getting optimum results, the strength characteristics showed an increasing trend between 28- 90 days curing period.

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue X Oct 2020- Available at www.ijraset.com

S. Antony Jeteandran, S. Kathirvel [2013] also investigated on durability characteristics of high volume fly ash concrete with and without fibres in comparison with conventional concrete for rigid pavements, the cement was replaced in the mix in proportions of 50%, 60%, 70% and the authors concluded that HFVA attained lesser impact strength and higher alkalinity when compared to design mix, the HFVA mixes are less workable and they also stated that a replacement of 50% suitable for HFVA concrete.

S. Pavan, S. Krishna Rao [2014] examined the potential usage of fly ash in roller compacted concrete pavements, a mix was prepares following standards of ACI-211-3R-19 guidelines and fly ash is replaced in that mix in varying proportions of 20%, 40%, and 60%. The compressive, flexural and split tensile strengths of mixes are examined. They concluded that the optimum results were attained for 20% replacement at 28 days and at higher replacement decrease in initial compressive strength and 50% of 28 day compressive strength were noticed.

Amit Kumar Ahirwar, Rajesh Joshi et.al [2015] studied the effect of replacement of fly ash in M30 grade of pavement quality concrete in increments of 10% in addition with coconut fibres in different proportions and found that at 30% addition the concrete mix showed optimum results when compared to conventional mix, they also concluded that the slump value decreased with increase in fly ash content.

Ramakrishnan. S, Velraj Kumar. G et.al [2014] experimentally investigated on the replacement of cement partially with rice husk ash in proportions of (0, 5, 10, 15, 20, 25%) for M40 grade of concrete. the variations in various strength parameters for the replacements are studied. The authors stated that there is a reduction in compressive, flexural and tensile strengths with increase in rice husk ash addition, the porosity and impact strength also decreased with increase in rice husk ash addition above 10% hence it is concluded that a replacement of 5-10% is optimum.

III. MATERIAL USED

A. Basic Materials

1) *Cement:* The use of cement for experimental studies was Ultra tech cement 43 grade OPC as specified in Indian Standard Code IS: 8112-1989. The gravitational force of cement was 3.10.

Table: Physical Properties of Cement

(a) Sr. No.	(b) Characteristics	(c) Experimental value	(d) Specified value as per IS:8112-1989
(e) 1	(f) Consistency of cement (%)	(g) 33%	(h) ---
(i) 2	(j) Specific gravity	(k) 3.10	(l) 3.15
(m)3	(n) Initial setting time (minutes)	(o) 63	(p) >30 As Per (q) IS 4031- (r) 1968
(s) 4	(t) Final setting time (minutes)	(u) 495	(v) <600 As per (w) IS 4031- (x) 1968
(y) 5	(z) Compressive strength (N/mm^2) (I) 3days (II) 7days (III) 28days	(aa) (bb) (cc) 20.45 (dd) 23.87 (ee) 33.50	(ff) (gg) (hh) >23 (ii) >33 (jj) >43
(kk) 6	(ll) Soundness (mm)	(mm) 1.00	(nn) 10
(oo) 7	(pp) Fineness of Cement	(qq) 5.5%	(rr)10% As Per (ss)IS 269-1976

2) *Coarse Aggregates:* The coarse aggregate used were a mixture of two locally available crushed stone of 20 mm and 10 mm size in 70:30 proportion. Coarse aggregate of maximum size 20mm and minimum 10 mm is used throughout the concrete. The specific gravity of coarse aggregate is 3.09.

3) *Fine Aggregates:* Fine aggregate is used in this experimental study for concrete is river sand conforming to zone- II. The specific gravity of fine aggregates 2.65.
4) *Fly Ash:* Fly Ash is a by-product of the combustion of pulverized coal in electric power generation plants ACC Cement Plant, Jamul, Bhilai. When the pulverized coal is ignited in the combustion chamber, the carbon and volatile materials are burned off. However, some of the mineral impurities of clay, shale, feldspars, etc., are fused in suspension and carried out of the combustion chamber in the exhaust gases. Specific Gravity of Fly Ash is 2.57.

Table: Physical Properties of FLY ASH

Physical property	Value
Colour	Whitish gray
Bulk density	1120 kg/m^3
Specific gravity	2.10
Fineness	2840 cm^2/gm

Table: Chemical Composition of FLY ASH

Oxide Composition	SiO2	Al2O3	Fe2O3	CaO	MgO	SO3	K2O	Na2O	L.O.I
Percentage (%)	55.3	25.70	5.30	5.60	2.10	1.40	0.60	0.40	1.90

Fig. Image of FLY ASH

5) *Rice Husk:* Rice Husk Ash is the ash that is obtained by burning the rice husk until it gets reduced by 25%. The Rice Husk for the research was obtained locally. These Husk then were deliberated until fine ash is being produced. These ashes were sieved by the 600 micron where further impurities are being minimized.

Table: Physical Properties of Rice Husk

Physical property	Value
Colour	gray with slight black
Bulk density	105.9 kg/m^3
Specific gravity	1.99
Fineness	2775 cm^2/gm
Avg. particle size	150.47μ m
Mesopores	78%
Heating value	9.68 MJ/kg

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue X Oct 2020- Available at www.ijraset.com

Table: Chemical Composition of Rice Husk

Oxide Composition	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	K_2O	Na_2O_3	L.O.I
Percentage (%)	88.32	0.46	0.67	0.67	0.44	2.91	0.12	5.81

Fig. Image of Rice Husk Ash

6) *Super Plasticizer:* The super plasticizer “GLENIUM™ B233” procured from SIKA India Pvt. Limited was used in this study. The dosage of super plasticizer recommended is 0.6% to 2% by weight of cement material.

Table Properties of Super Plasticizers

Sr. No.	Characteristics	Values
1	Type	Poly carboxylic ether (PCE)
2	Form	Liquid
3	Colour	Light Brown
4	Specific Gravity	1.09
5	Relative density	1.09 ± 0.01 at 250C
6	PH Content	> 6
7	Setting Time	There may be mild extension of initial or final set

7) *Water:* Water used for mixing and curing was clean and free from injurious amounts of oils, acids, alkalis, salts and sugar, organic substances that may be deleterious to concrete. As per IS 456- 2000 Potable water is generally considered satisfactory for mixing and curing of concrete. Accordingly, potable tap water was used for the preparation of all concrete specimens.

IV. METHODOLOGY

A. Mix Design

1) *Step 1:* As per clause 602 of MORT&H Specification

a) *Cement:* 43 grade OPC as per IS 8112 as per 602.2.2 Coarse aggregate – 20 mm and 10 mm as per 602.2.4 Los angles Abrasion value not greater than 35% Impact value not greater than 30%

b) *Fine Aggregate:* Natural sand as per IS 383

c) Admixture: Conplast AEA (if required)

d) Air entrained concrete 5% maximum (optional)

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue X Oct 2020- Available at www.ijraset.com

2) *Step 2:* Design Parameter

a) Characteristics flexural strength required at 28 days = 4.5 N/mm2
b) Maximum water cement ratio = 0.40 as per clause 602.3.3.1
c) Maximum size of coarse aggregate = 25 mm
d) Degree of quality control = Good
e) Minimum cement content = 350 kg/m3 as per clause 602.3.2
f) Maximum cement content = 425 kg/m3 as per clause 602.3.2

3) *Step 3:* Calculation of Aggregate Content

After determining the weight per cubic meter of cement, water, coarse aggregate and percentage of air content, the fine aggregate is calculated so as to produce one cubic meter of concrete using absolute volume method. On converting the weight per cubic meter into volume, we have

a) Volume of cement =
b) Volume of coarse aggregate =
c) Volume of water =
d) Volume of fine aggregate = 1 – {Volume of cement + coarse aggregate + water +Air content}
e) Weight of fine aggregate = Volume of fine aggregate specific gravity 1000

Table: Outline of the Experimental Program

S. No.	Mould ID	Cement %	Fly Ash %	Rice Husk Ash %
1	M0	100	0	0
2	M1	90	10	0
3	M2	80	20	0
4	M3	70	30	0
5	M4	90	0	10
6	M5	80	0	20
7	M6	70	0	30
8	M7	80	10	10
9	M8	70	20	10
10	M9	70	10	20

Now by following the above steps for mix design, the mix proportion for different mixes are given by using following data:

Table: Mix Design for Pavement Concrete

Mean Target Flexural strength (MPa)	Max. Size of Aggregate, (mm)	Mix proportions (C : FA : CA-I : CA-II)	W/C Ratio
4.5	20	1 : 1.825 : 1.94 : 0.85	0.4
5	20	1 : 1.82 : 1.92 : 0.81	0.35
5.5	20	1 : 1.80 : 1.90 : 0.80	0.3

B. Moulds

To determine the compression strength of the fly ash and rice husk concrete, cubes of 150mm×150mm×150mm size were used. For flexural strength test, beams of 150mm×150mm×700mm size were used.

V. RESULTS

The research was undertaken to investigate the compressive strength and flexural strength of concrete with different levels of replacement of cement with fly ash and rice husk ash in concrete mix. Cement was partially replaced by fly ash at three different levels of replacement i.e. 10%, 20% and 30% and same with rice husk ash. Concrete mixtures were also cast with combined replacements of fly ash and rice husk ash in a standard laboratory of SSTC SSGI Bhilai. The moulds were fully compacted using table vibrator so the air voids are completely removed. The Cubes and beams were casted is kept in a water tank (fully immersed in water) for different curing period.

Tests were performed after 7 and 28 days of proper curing of concrete.

Table: Compressive strength of cube when cement is replaced by Fly Ash and Rice Husk for 4.5 MPa Strength

S. No	Percentage Replacement Of Cement (%)			Compressive Strength (MPa)	
	Cement %	Fly Ash %	Rice Husk %	7 Days	28 Days
Mix 1	100	0	0	38.49	51.34
Mix 2	80	10	10	21.17	32.44
Mix 3	70	20	10	16.57	27.48
Mix 4	70	10	20	15.76	25.94

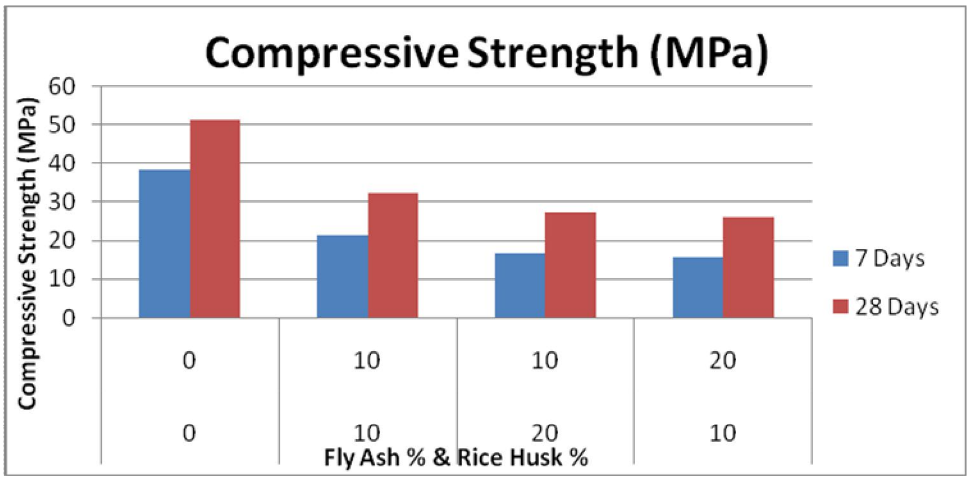


Fig. Variation of compressive strength with variation of Fly Ash & Rice Husk

Table: Compressive strength of cube when cement is replaced by Fly Ash and Rice Husk for 5 MPa Strength

S. No	Percentage Replacement Of Cement (%)			Compressive Strength (MPa)	
	Cement %	Fly Ash %	Rice Husk %	7 Days	28 Days
Mix 1	100	0	0	40.82	56.95
Mix 2	80	10	10	23.87	34.94
Mix 3	70	20	10	20.93	32.27
Mix 4	70	10	20	18.24	30.56

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue X Oct 2020- Available at www.ijraset.com

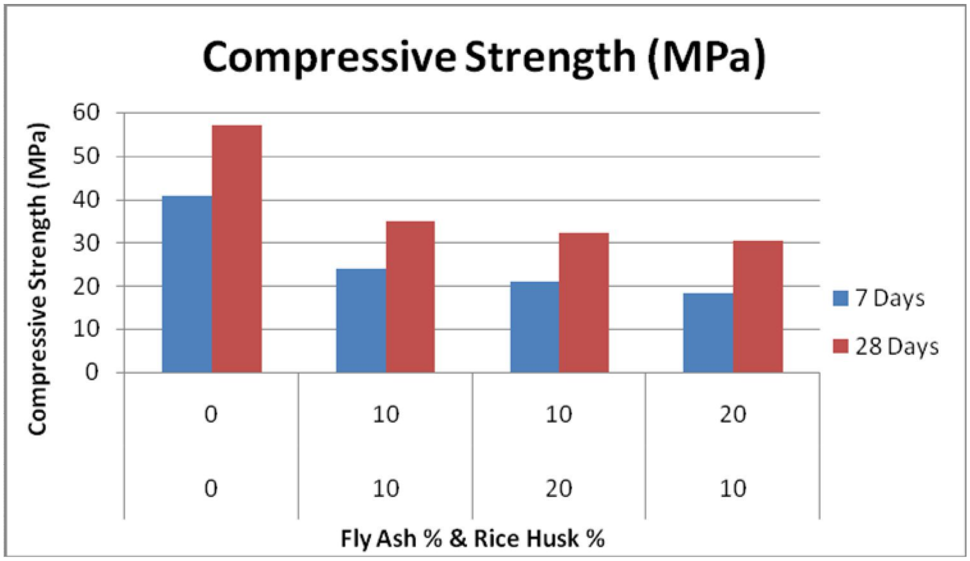


Fig. Variation of compressive strength with variation of fly ash & rice husk

Table: Compressive strength of cube when cement is replaced by Fly Ash and Rice Husk for 5.5 MPa Strength

S. No	Percentage Replacement Of Cement (%)			Compressive Strength (MPa)	
	Cement %	Fly Ash %	Rice Husk %	7 Days	28 Days
Mix 1	100	0	0	46.54	61.57
Mix 2	80	10	10	30.57	44.59
Mix 3	70	20	10	25.87	39.76
Mix 4	70	10	20	22.33	36.10

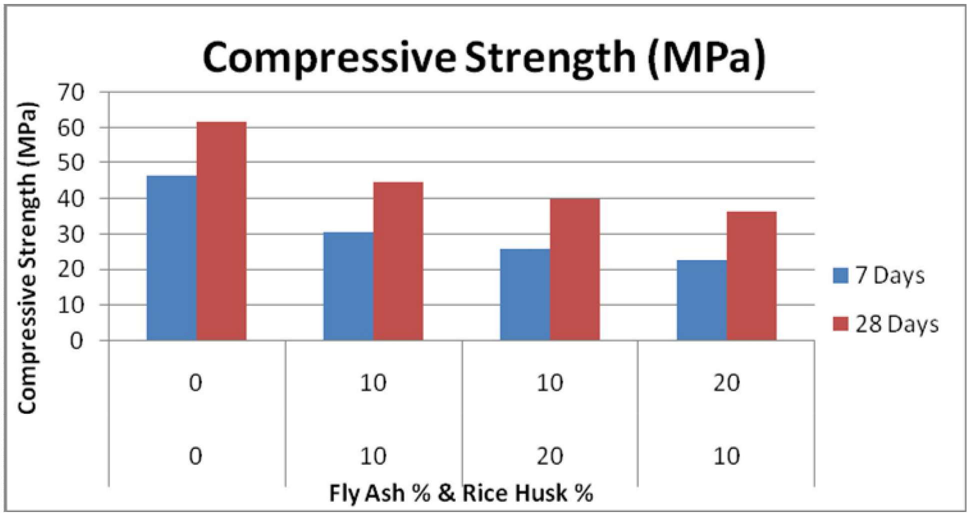


Fig. Variation of compressive strength with fly ash and rice husk.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue X Oct 2020- Available at www.ijraset.com

Table: Flexural strength of beam when cement is replaced by fly ash& rice husk for 5.5 MPa Strength

S. No	Percentage Replacement Of Cement (%)			Flexural Strength (MPa)
	Cement %	Fly Ash %	Rice Husk %	28 Days
Mix 1	100	0	0	6.19
Mix 2	80	10	10	4.10
Mix 3	70	20	10	3.76
Mix 4	70	10	20	3.56

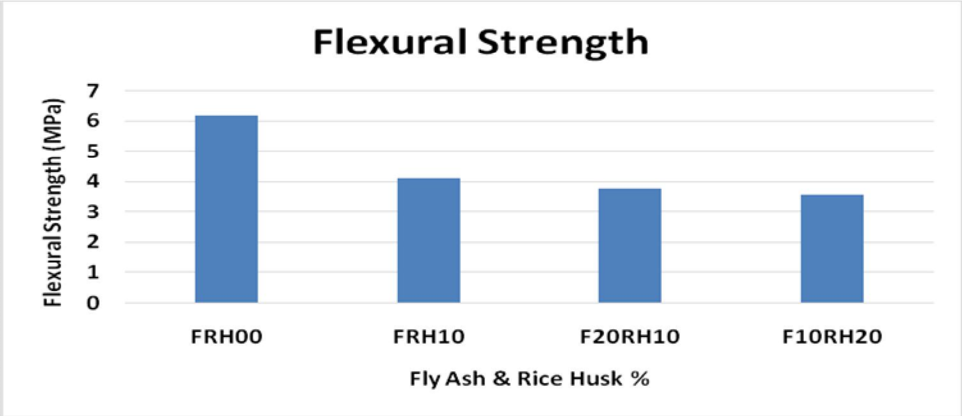


Fig. Variation of flexural strength with variation of fly ash and rice husk

Table: Flexural strength of beam when cement is replaced by fly ash & rice husk for 5 MPa Strength

S. No	Percentage Replacement Of Cement (%)			Flexural Strength (MPa)
	Cement %	Fly Ash %	Rice Husk %	28 Days
	100	0	0	5.90
Mix 2	80	10	10	3.90
Mix 3	70	20	10	3.57
Mix 4	70	10	20	3.25

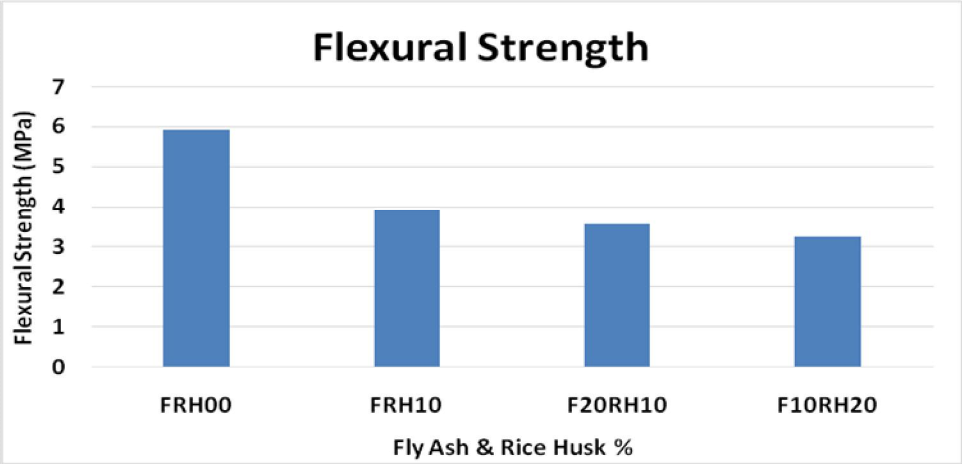


Fig: variation of flexural strength with variation of fly ash & rice husk

Table: Flexural strength of beam when cement is replaced by fly ash & rice husk for 4.5 MPa Strength

S. No	Percentage Replacement Of Cement (%)			Flexural Strength (MPa)
	Cement %	Fly Ash %	Rice Husk %	28 Days
Mix 1	100	0	0	5.30
Mix 2	80	10	10	3.51
Mix 3	70	20	10	3.37
Mix 4	70	10	20	2.98

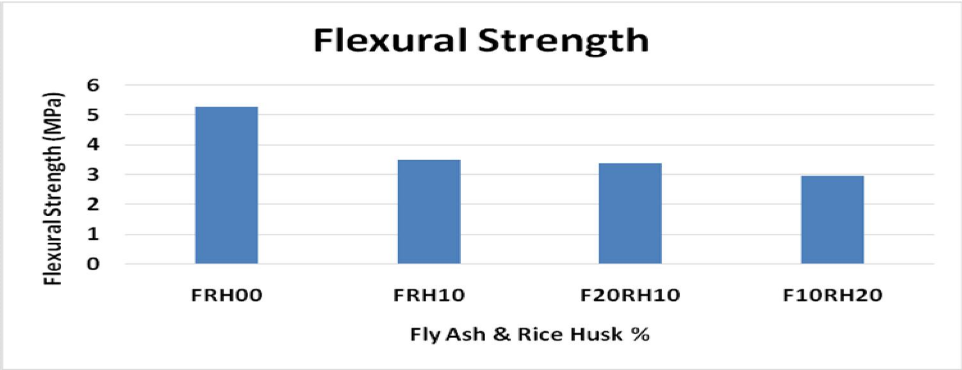


Fig: Variation of flexural with variation of fly ash & rice husk

VI. CONCLUSIONS

A. Combined replacement of fly ash and rice husk ash in w/c = 0.3 & 0.35 showed higher compressive strengths than only replacement of cement with rice husk ash.

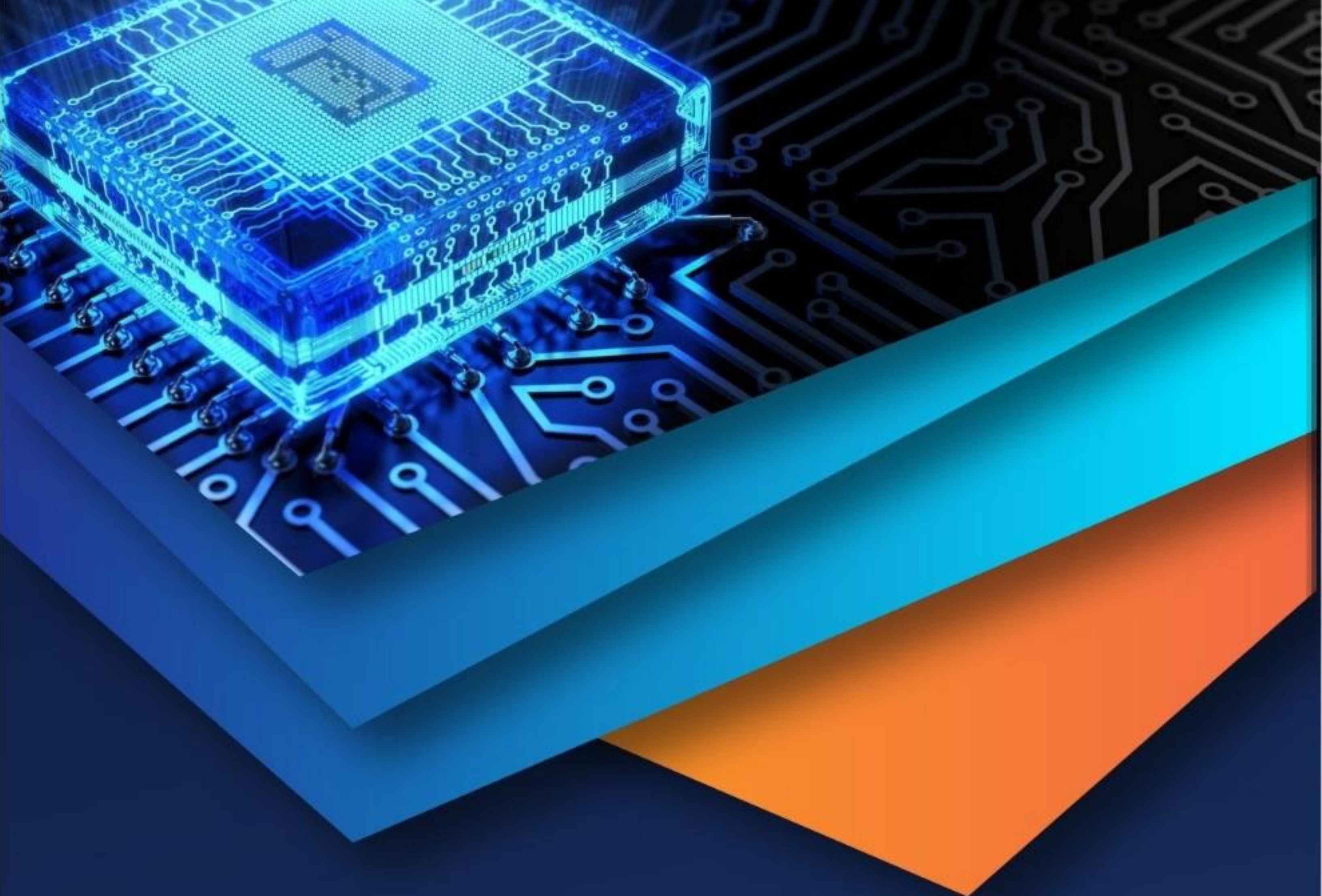
B. Concrete mixes with combined replacement of fly ash and rice husk ash in all water-cement ratios had lesser compressive strengths than minimum required as per MORTH specifications.

C. The mixes containing only fly ash replacement could achieve 85 to 95% of the control strength, whereas, the mixes containing only 30% rice husk as replacement achieved only 55% of the target controlled strength.

D. Fly ash up to 10 to 25% replacement for all the water-cement ratios showed higher flexural strengths than minimum required flexural strengths as per pavement quality control design standards. Thus, cement replacement by fly ash can be used in designing pavement quality concrete mixes.

REFERENCES

[1] Nagesh Tatoba, SuryawanshiSamitinjay S Bhansode et al, "Usage of Eco Friendly Material like Fly Ash in Rigid Pavement Construction and Its Cost-
[2] Benefit Analysis" International Journal of Emerging Technology and Advanced Engineering, Vol-4, Issue-12, December 2012, e-ISSN 2250-2459
[3] Vanitha Agarwal, Gupta S.M, Sachdeva S.N, "Investigations on Fly Ash Concrete for Pavements", International Journal of Civil and Structural Engineering, Vol-2, Issue-3, 2012, ISSN-0976-4399.
[4] S. Antony jeteandran, S. Kathirvel, "Durability Study on High Volume Fly Ash Concrete With and Without Fibres for Pavements", International Journal of Advanced Structures and Geotechnical Engineering, Vol- 3, Issue-4, December- 2014, e-ISSN: 2319-5347.
[5] S. Pavan, S. Krishna Rao, "Effect of Fly Ash on Strength Characteristics of Roller Compacted Concrete Pavement", IOSR International Journal of Mechanical and Civil Engineering, Vol-11, Issue-6, Nov-Dec 2014, pp-04-08, e-ISSN: 2278:1614.
[6] Amit Kumar Ahirwar, Rajesh Joshi, Kapil Soni, "Laboratory Analysis of Fly Ash Mix Concrete for Rigid Pavements", International Journal of Engineering Research and Applications, Vol-5, Issue-2, February-2015, pp-86-91, e-ISSN: 2248-9622.
[7] Ramakrishnan. S, Velraj Kumar. G, Ranjith. S, "Behaviour of Cement Rice Husk Ash Concrete for Pavement", International Journal of Emerging Trends in Engineering and Development, Vol-1, Issue-4, January 2014, e- ISSN-2249-6149.
[8] Jiendar Kumar, Varinder Singh, Ravi Kanth Pareek, "A Study on Effect of Fly Ash and Rice Husk Ash on Strength Parameters of Pavement Quality Concrete", International Journal on Emerging Technologies, Vol-6, Issue-2, pp-28-34, 2015, e-ISSN-2249-3255.
[9] Rohit Siwach, S.S Kajal, Nikitha Rajpal, "Effect of Fly Ash and Rice Husk Ash on Strength Characteristics of Pavement Quality Concrete", International Journal of Science Engineering and Technology Research, Vol-4, Issue-7, July 2015, e-ISSN 2278-7798.
[10] Mahesh Bhai Prajapathi, Jayesh Kumar Pitroda, "Use of Rice Husk Ash and Steel Fibre Concrete in Rural Road", International Journal of Advanced Research and Innovative Ideas in Engineering, Vol-2, Issue-3, 2016, e- ISSN 2395-4396.
[11] M.M. Sravanan, M. Sivaraja, "Mechanical Properties of High Strength Concrete with Basalt Fibre", International Journal of Advanced Engineering and Technology, Vol-7, Issue-2, April-June 2016, ISSN- 9036-3945.



10.22214/IJRASET

INDEX COPERNICUS
45.98

IMPACT FACTOR:
7.129

TOGETHER WE REACH THE GOAL

IMPACT FACTOR:
7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY