



e-ISSN: 2319-8753 | p-ISSN: 2320-6710

IJRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 9, Issue 12, December 2020

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 7.512

9940 572 462

6381 907 438

ijirset@gmail.com

www.ijirset.com

Validation by Regression Technique for Compressive Strength and Flexure Strength of Concrete

Kashid Prashant Ankush¹, Prof. S. S. Kadam²

P.G. Student, S. K. N. Sinhgad College of Engineering, Korti, Pandharpur, Maharashtra, India¹

Assistant Professor, S. K. N. Sinhgad College of Engineering, Korti, Pandharpur, Maharashtra, India²

ABSTRACT: This paper dealt with the statistical analysis by using regression technique to estimate the relationships between the variables of test. Regression analysis helps you understand how the dependent variable changes when one of the independent variables varies and allows to mathematically determine which of those variables really has an impact. Technically, a regression analysis model is based on the sum of squares, which is a mathematical way to find the dispersion of data points. The goal of a model is to get the smallest possible sum of squares and draw a line that comes closest to the data. In our study, R^2 is 0.92, which is fairly good. It means that 92% of our values fit the regression analysis model. In other words, 92% of the dependent variables (y-values) are explained by the independent variables (x-values). Generally, R Squared of 95% or more is considered a good fit.

KEYWORDS: Rice Husk Ash (RHA), Steel Fibre (SF), Regression Technique.

I. INTRODUCTION

In this emerging era of construction industry, concrete and cement mortar are commonly used by the construction professionals and traders, this development induce a large amount air pollution resulted from cement manufacturing industry and by seeing the previous track it can be easily predict that cement demand will increase in future also and if these production are not properly managed it will create severe problems, keeping the environment in mind.

The problems associated with the safeguard of the environment makes it enforced to consuming waste an essential element in the construction industry. Waste can be used to produce required materials or to improve the quality of existing building materials. The developing countries have a problem concerning waste as it results in the rise in pollution. This problem could be solved through the recycling of these materials into new construction materials. This could serve as a way of reducing the high cost of construction materials in developing countries. Supplementary Cementitious Materials (SCM) also reduce the cost related with construction while providing “green” concrete with its similar or improved mechanical properties. They are thus usually used in concrete in a combined form or added into concrete mixtures.

In this research, the analysis has been carried out as per IS method and parameters are kept constant for the experimental work. The manufacturing of the concrete cubes need to be cast in 150 mm cube. The total number of specimen which were prepared 126 cubes and were casted with proper curing and the series of tests were conducted on these specimens like compressive strength and flexure test.

For last few decades, there are many concerns raised for the continuous increase of cement use because the manufacturing of cement causes enormous amount of CO₂ emission and it also consume noteworthy amount of natural rock and minerals that may prime to deplete at one point of time. Manufacture of one tone of Portland cement (PC) generates about one ton of CO₂ to the atmosphere which constitutes 5% global CO₂ emission (Worrell, 2001 as cited by Gaurav and Amit, 2015). Approximately 8% - 10% of the CO₂ emissions in the world come from the manufacturing of cement; this makes it a crucial area when it comes to the mitigation approaches concerned with the reduction of CO₂ emissions (Ernst Worrell et al, 2001 as cited by Gupta and Wayal, 2015). Due to increase in the cost of conventional building materials and environmental threat, the designers and developers are looking for ‘alternative materials’ to reduce the use of cement in construction practices.

It is well known, concrete is good in compression but weak in tension, so in order to improve the strength of concrete partial replacement of cement by RHA are used along with the addition of steel fibers. The effects of RHA with steel fibers on strength characteristics and durability performance of concrete will be investigated in this research.



II. AIM & OBJECTIVE OF STUDY

“The vital goal of this research paper is, to learn the partial replacement of cement by rice husk ash and its combine effect with optimal percentage of steel fiber with it for the overall betterment of construction industry practice and environment”

Following are the key objectives of this research and thesis

1. To study the combined effect of different percentage of Steel Fiber with optimum percentage of Rice Husk Ash in concrete.
2. Validation of experimental results of compressive and flexure strength with regression techniques.

III. LITERATURE REVIEW

An extensive literature review has been carried out to explore the background information on current knowledge related to the research topic.

TABLE I
RESEARCH PAPER ON RHA

Year of Publish	Title of Research Paper	Test conducted for various RHA (%)	Optimum RHA (%)	Properties	Effect
2017	Rice husk ash as a partial replacement of cement in high strength concrete containing micro silica	5, 10, 15, 20 and 25	20	Compressive Strength	+ 6.9 %
				Tensile Strength	+6.8 %
				water Permeability	-26%
				chloride Permeation	-78%
				RHA has potential to partial replace	
2012	Effect of RHA as Partial Replacement of Cement on Concrete Properties	0, 10, 20, 30 and 40	20	Workability	Decrease
				Compressive Strength	Increase
				Shrinkage	No effect
				Setting Times	Increases
				RHA has potential to partial replace	
2013	Performance Evaluation of Steel Fibres in Rice Husk Ash Substituted Concretes	10 & 20	10	Compressive Strength	Increase
				Tensile Strength	Increase
				RHA has potential to partial replace	
2014	Effect of Rice Husk Ash on Properties of Concrete	10, 20 & 30	20	Compressive Strength	Increase
				Tensile,	Increase
				Flexure	Increase
				Compressive Strength	Increase
2014	Use Of Rice Husk Ash As Partial Replacement For Cement In Concrete	0, 5, 10, 15, 20 and 25	0 -20	Compacting Factor	Decrease
				Compressive Strength	Increase
				RHA has potential to partial replace but recommended further study	
				Cost	-(7-10)%
2015	Effect of Partial Replacement of Cement by Rice Husk Ash in Concrete	5, 10, 15 & 20	10	Compressive Strength	Increase
				RHA has potential to replace in High grade of concrete (M30)	
2017	Experimental Study on Rice Husk Ash in Concrete by Partial Replacement	0, 10, 12.5 & 15	12.5	Tensile Strength	Increase
				Flexural Strength	Increase
				Compressive Strength	Increase
				RHA has potential to replace in High grade of concrete (M40)	
2017	An Experimental Study on Rice Husk Ash as	0, 10, 20, 30, & 40	20	Flexural Strength	Increase
				Compressive Strength	Increase



	Partial Replacement for Cement in Concrete			Cost	Decrease
				RHA has potential to partial replace	
2018	Characteristics of Fibre-Reinforced Rice Husk Ash Concrete on Strength	7.5, 10, 12.5, 15 & 17.5	15	Flexural Strength	Increase
				Compressive Strength	Increase
				Cost	Decrease
				RHA has potential to partial replace	

TABLE II
RESEARCH PAPER ON SF

Year of Publish	Title of Research Paper	Test conducted for various Steel Fiber (%)	Optimum SF (%)	Properties	Effect
2016	Effect of Partial Replacement of Cement by Fly Ash, Rice Husk Ash with Using Steel Fiber in Concrete	0, 0.25, 0.5, 0.75 & 1.0	0.75	Compressive Strength	Increase
				Flexural Strength	Increase
				The replacement of cement with 7.5% RHA and 0.75% glass fiber shows the best result	
2018	Characteristics of Fibre-Reinforced Rice Husk Ash Concrete on Strength	0, 0.5, 1.0, 1.5 & 2.0	1.5	Compressive Strength	+29.79%
				Splitting Tensile Strength	+15.44%
				Flexural Strength	+47.61%
				The replacement of cement with 15% RHA and 1.5% glass fiber shows the best result	
2019	Optimization of Mechanical Properties of Glass Fiber Reinforced Concrete with the Combination of Rice Husk Ash	0, 0.5, 1.0 & 1.5	1	Compressive Strength	Increase
				Flexural Strength	Increase
				The replacement of cement with 10% RHA and 1% glass fiber shows the best result	
2019	Experimental Study on Strength of Concrete by Using Artificial Fibers with Rice Husk Ash	0, 0.25, 0.5, 0.75 & 1.0	0.75	Splitting Tensile Strength	Increase
				Flexural Strength	Increase
				The replacement of cement with 12.5% RHA and 1% glass fiber shows the best result	
2020	Experimental study on steel fibre reinforced concrete with a partial replacement of cement by rice husk ash	0.5, 1 & 1.5	1.5	Compressive Strength	Increase
				Splitting Tensile Strength	Increase
				Flexural Strength	Increase
				The replacement of cement with RHA and glass fiber shows significant result	



IV. MATERIAL

Although all materials that go into concrete mix are essential. The properties of material used for making concrete mix are resolute in laboratory as per relevant code of practice. Different materials used in present study were cement, coarse aggregates, fine aggregates, Rice husk Ash and steel fibers.

A. Cement

Aditya Birla Cement Company, Ordinary Portland Cement (OPC) of 43 Grade of an Ultra tech brand from a single lot was used throughout the course of the investigation. It was fresh and without any lumps. The physical properties of the cement as determined from third party certification to the lot were conforming to Indian Standards IS: 8112:1989.

B. Fine Aggregate

The sand used for the work was locally procured and conformed to Indian Standard Specifications IS: 383-1970. In this experimental program, fine aggregate (stone dust) were collected from Shree Siddhivinayak Stone Crusher, Waghawadi and conforming to Grade Zone I. It was coarse sand light brown in colour.

C. Course Aggregate

Locally available coarse aggregate having the maximum size of 20 mm was used in this work. The aggregates were tested as per IS: 383-1970. The aggregates were washed to remove dirt, dust and then dried to surface dry condition.

D. Rice Husk Ash

Rice husk ash used in investigation has been obtained from ASHVINI TRADERS. It is Parboiled rice unit located in Chandrashekhar Ward, Gondia. The Specific gravity of rice husk ash sample is 2.28.

E. Steel Fiber

Mild steel fibers used in this investigation are purchased from Mega Fiber from Bhosari Gaonthan area, Pune having 30 mm length and 0.6 mm thickness i.e. aspect ratio (L/d) 50 which are corrugated and obtained through respective cutting of steel wires to have a good workability in used.

F. Water

The potable water is generally considered satisfactory for mixing and curing of concrete. Accordingly potable water was used from laboratory tap for making concrete. The water was clean, free from any visible impurities and any detrimental contaminants and was good to be used quality.

V. RESULT AND DISCUSSION

The test has been performed in standard size 150 X 150 X 150 mm to check the compressive strength with mix for various percentage of steel fiber and replacement of Rice husk Ash has been illustrated in tabular form as follows.



Fig 1: Sequence of Mixing (From Top Left Corner in Clockwise Direction): i) Cement & fine aggregate mixed ii) Course aggregate mixed iii) Water is added iv) All material are mixed appropriately

Fig 2: (From Top Left to right) i) Adding water in Mixing ii) Mixing constituents of specimen iii) Molds with oiling from inner side iii) Final layer of mold finishing iv) Curing of beams v) Beams specimen for testing

TABLE III
COMPRESSIVE STRENGTH OF CUBE SPECIMEN AT VARIOUS INTERVALS

Srl No.	Composition of concrete	7 days	14 days	28 days
1	RHA 0% / SF 0%	27.0	37.6	48.3
2	RHA 5% / SF 0%	26.6	36.7	46.7
3	RHA 10% / SF 0%	26.4	36.4	46.3
4	RHA 15% / SF 0%	25.1	33.2	41.3
5	RHA 20% / SF 0%	23.4	30.1	36.7
6	RHA 25% / SF 0%	21.6	28.8	35.9
7	RHA 5% / SF 0.5%	26.7	37.4	48.1
8	RHA 10% / SF 0.5%	26.8	37.5	48.3
9	RHA 15% / SF 0.5%	23.7	33.6	43.6
10	RHA 20% / SF 0.5%	22.0	29.8	37.7
11	RHA 25% / SF 0.5%	20.5	27.9	35.2
12	RHA 5% / SF 1%	27.0	38.1	49.1
13	RHA 10% / SF 1%	27.6	38.5	49.5
14	RHA 15% / SF 1%	25.4	34.6	43.8
15	RHA 20% / SF 1%	22.6	30.7	38.7
16	RHA 25% / SF 1%	20.9	29.3	37.6
17	RHA 5% / SF 1.5%	27.6	38.4	49.2
18	RHA 10% / SF 1.5%	28.3	39.6	50.9
19	RHA 15% / SF 1.5%	25.1	35.0	45.0
20	RHA 20% / SF 1.5%	22.2	31.0	39.8
21	RHA 25% / SF 1.5%	21.8	29.5	37.2

Above table clearly showing the variation of compressive strength, it is also observed that with the increase in percentage of steel fiber the strength increases. This happens because when steel fibers are added to concrete, the propagation of cracks was restrained due to the bonding of fibers into the concrete (ductile failure). Also it is observed that one of the most desirable benefits of adding fibers to concrete is to increase its energy absorbing capability or saying more precisely ductility. Referring to the graphs of above section, it is observed that for addition of 1.5% steel fiber and replacement of cement with 10% Rice husk Ash, the compressive strength increases the most when compared to nominal mix.

The test has been performed in standard size 150 X 150 X 700 mm to check the flexure strength with mix for various percentage of steel fiber and replacement of Rice husk Ash in flexure test machine has been illustrated in tabular as follows.

TABLE IV
FLEXURE STRENGTH OF CUBE SPECIMEN AT VARIOUS INTERVALS

Srl No.	Composition of concrete	7 days	14 days	28 days
1	RHA 0% / SF 0%	4.26	4.81	5.35
2	RHA 5% / SF 0%	4.10	4.66	5.21
3	RHA 10% / SF 0%	3.83	4.35	4.86
4	RHA 15% / SF 0%	2.80	3.56	4.32
5	RHA 20% / SF 0%	2.52	3.16	3.80
6	RHA 25% / SF 0%	2.20	2.87	3.54



7	RHA 5% / SF 0.5%	4.03	4.58	5.12
8	RHA 10% / SF 0.5%	3.80	4.44	5.08
9	RHA 15% / SF 0.5%	2.94	3.68	4.41
10	RHA 20% / SF 0.5%	2.65	3.32	3.99
11	RHA 25% / SF 0.5%	2.34	2.95	3.55
12	RHA 5% / SF 1%	4.20	4.75	5.30
13	RHA 10% / SF 1%	4.10	4.70	5.29
14	RHA 15% / SF 1%	3.09	3.81	4.52
15	RHA 20% / SF 1%	2.78	3.49	4.19
16	RHA 25% / SF 1%	2.53	3.26	3.98
17	RHA 5% / SF 1.5%	4.35	4.86	5.37
18	RHA 10% / SF 1.5%	4.43	5.04	5.64
19	RHA 15% / SF 1.5%	3.93	4.68	5.43
20	RHA 20% / SF 1.5%	2.97	3.84	4.7
21	RHA 25% / SF 1.5%	2.65	3.47	4.29

Above section clearly showing the variation of flexure strength, it is also observed that with the increase in percentage of steel fiber the strength increases. This happens because when steel fibers are added to concrete, the propagation of cracks was restrained due to the bonding of fibers into the concrete (ductile failure). Also it is observed that one of the most desirable benefits of adding fibers to concrete is to increase its energy absorbing capability or saying more precisely ductility. Referring to the graphs of above section, it is observed that for addition of 1.5% steel fiber and replacement of cement with 10% Rice husk Ash, the flexure strength increases the most when compared to nominal mix.

Regression analysis helps you understand how the dependent variable changes when one of the independent variables varies and allows to mathematically determining which of those variables really has an impact. Technically, a regression analysis model is based on the sum of squares, which is a mathematical way to find the dispersion of data points. The goal of a model is to get the smallest possible sum of squares and draw a line that comes closest to the data.

The result obtained from the structured experimental data in controlled environment of laboratory a liner presentation of the strength acquired in represented in graphical format in this section. The x-axis and y-axis are the strength acquired of compressive strength after 7 days and 28 days of curing in experimental study respectively.

R² is the Coefficient of Determination, which is used as an indicator of the goodness of fit. It shows how many points fall on the regression line is 0.9258 and the equation formed as $y = 2.0289x - 6.7948$, we will see the interpretation of various values in the following sections.

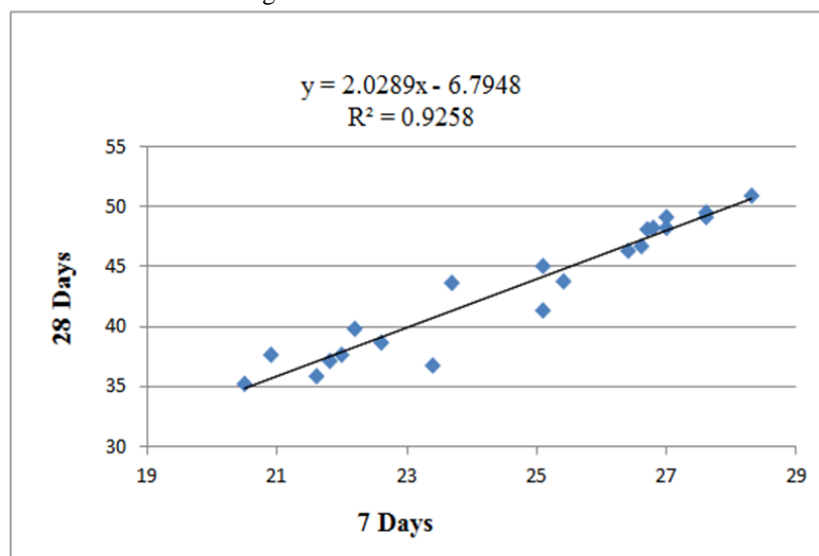


Fig. 1: Graphical Representation of Compressive Strength acquired in 7 & 28 Days

Table V
Regression Statistics

Regression Statistics	
Multiple R	0.9621786
R Square	0.9257876
Adjusted R Square	0.9218817
Standard Error	1.4840611
Observations	21

VI. CONCLUSION

Concrete mix with 10 percent Rice husk Ash as replacement of cement and 1.5% addition of steel fiber is the optimum level and it has been observed to show a significant increase in compressive strength at 7days, 21 days and 28 days when compared with nominal mix.

The flexure strength also tends to increase with the increase percentage of steel fiber, a trend similar to increase in compressive strength. On increasing the percentage replacement of cement with Rice husk Ash beyond 10%, there is significantly decrease in compressive and flexure strength value.

In our study, R^2 is 0.92, which is fairly good. It means that 92% of our values fit the regression analysis model. In other words, 92% of the dependent variables (y-values) are explained by the independent variables (x-values). Generally, R Squared of 95% or more is considered a good fit.

REFERENCES

- [1] Achilleos, Constantia, et al. "Proportioning of steel fibre reinforced concrete mixes for pavement construction and their impact on environment and cost." *Sustainability* 3.7 (2011): 965-983.
- [2] Chunxiang, Qian, and Indubhushan Patnaikuni. "Properties of high-strength steel fibre- reinforced concrete beams in bending." *Cement and Concrete Composites* 21.1 (1999): 73-81.
- [3] Elsaigh, WA, Kearsley, EP and Robberts, JM. "Steel Fibre Reinforced Concrete for Road Pavement Application". Paper Presented to the 24 th Annual Southern African Transport Conference (2005), South Africa.
- [4] G.Murali, C.M. VivekVardhan, P.Sruthee, P.Charmily. "Influence of Steel Fibre on Concrete." *International Journal of Engineering Research and Applications (IJERA)* ISSN:2248-9622 (2012), Vol.2, Issue 3, pp.075-078.
- [5] Naik TR, Kraus RN Chun YM, Ramme WB, Singh SS. Properties of field manufactured cast-concrete products utilizing recycled materials. *J mater Civil Eng* 2003;15(4): 400-7.
- [6] Naik, Tarun R. "Foundry industry by-products utilization. "University of Wisconsin- Milwaukee, Department of Civil Engineering and Mechanics, Center for By-Products Utilization, Report No. CBU-1989-01 (1989).
- [7] Nataraja, .C., N. Dhang, and A.P. Gupta. "Stress-strain curves for steel-fibre reinforced concrete under compression." *Cement and Concrete Composites* 21.5 (1999): 383-390.
- [8] Patel, Mr VR, Bhavin R. Mojidra, and I. I. Pandya. "Ultimate Shear Strength of Fibrous Moderate Deep Beams without Stirrups." *International Journal of Engineering* 1.1 (2012): 16-21.
- [9] Rashid, Mohammad Abdur, and Mohammad Abul Mansur. "Considerations in producing high strength concrete." *Journal of Civil Engineering (IEB)* 37.1 (2009): 53-63.
- [10] Soulioti, D. V., et al. "Effects of Fibre Geometry and Volume Fraction on the Flexural Behaviour of Steel-Fibre Reinforced Concrete." *Strain* 47.21 (2011): e535-e541.
- [11] Sydney Furlan Jr. and Joao Bento de Hanai. "Shear Behaviour of Fibre reinforced Beams". *Cement and Concrete Composites* 19 (1992) 359-366.
- [12] Wang, Nianzhi, Sidney Mindess, and Keith Ko. "Fibre reinforced concrete beams under impact loading." *Cement and concrete research* 26.3 (1996): 363-376.
- [13] Wegian, Falah M., A. Alanki, and A. Alotaibi. "Influence of Fly Ash on Behaviour of Fibres Reinforced Concrete Structures." *Journal of Applied Sciences* 11.17 (2011): 3185- 3191.



INNO SPACE
SJIF Scientific Journal Impact Factor

**Impact Factor:
7.512**

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 9940 572 462  6381 907 438  ijirset@gmail.com



www.ijirset.com

Scan to save the contact details