AN EXPERIMENTAL STUDY ON GLASS FIBER REINFORCED CONCRETE USING RICEHUSK ASH AS PARTIAL REPLACEMENT IN CEMENT

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ABSTRACT

The infrastructure needs of our country is increasing day by day and with concrete is a main constituent of construction material in a significant portion of this infra-structural system. It is necessary to enhance its characteristics by means of strength and durability. It is also reasonable to compensate concrete in the form of using waste materials and saves in cost by the use of admixtures such as byproducts, fly ash, silica fume, etc. as partial replacement of cement. The composite matrix that is obtained by combining cement, byproducts, aggregates and fibers is known as “By products Fiber reinforced concrete”. The fiber inthe cement byproducts-based matrix acts as crack- arresters, which restrict the growth of micro cracks and prevent these from enlarging under load. The experimental work has carried out to study the effects of replacement of cement rice husk ash(by weight) with (5%, 10%, 15%,20%). By products and the effects of addition of (0.5%, 1%, 1.5%) Glass Fiber composite. A M40 Grade of concrete is designed. This study reports the feasibility of use of Glass fibers, by products, super plasticizers, air entraining agents and accelerators content on structural properties such as compressive strength, splittensile strength, and flexural strength test.

I. INTRODUCTION

In India, the manufacturing of Portland cement was commenced around the year 1912. The beginning was not very promising and growth of cement industry was very slow. At the time of independence in 1947, the installed capacity of cement plants in India was approximately 4.5 million tons and actual production around 3.2 million tons per year. The large constructionactivity undertaken during the various 5 years plans mainly during the necessitated the growth of cement industry. However, the five-year plans envisaged for Multi-purpose projects and also for rapid industrial growth remained stinted due to the complete control exercised by the Government over the cement industry. As the infra structure sector was developing during 1980’s prompted the various industrial organizations were interested for setup new cement plants in the country. The full liberalization on cement industry in 1988 further provided rapid expansion for the growth.

The installed capacity in the 1982 was nearly 30 million tons, which has now, increase to nearly 262.6 million tons during a period of 30 years.Today India is second largest country after China in production of cement. In addition, there have been significant developments in the improvement of the quality of cement as well as availability of variety of cements in the markets. The production of superior quality of ordinary Portland cement (OPC) in the country was primarily responsible for introducing the grading system in OPC by Bureau of Indian standard (BIS) during 1986-87. The other varieties of structural cements, such as sulphate resisting Portland cement, pozzolana cement and blast furnace slag cement found their way to improve quality and prompted the structural engineers and major consumers to adopt higher grades of concretes in the construction work. This has been marked difference in the quality of concrete during this period primarily due to theavailability of superior quality of cements in the market. In addition, there has been a continuous up gradation in the availability of product knowledge, product quality and marketing services to the consumers. The trend is continuing and more and more varieties of cements are coming to the market which help the consumers to make appropriated grade and quality of concrete to meet the specific construction requirement.

Scope of the project:

It is observed that different study reports have been brought to light as regards the evaluation of individual effectiveness of Rice husk ash, By products and Glass Fiber blended concrete. Nevertheless, there is a scarcity in respect of the study reports which focused on the joint implementation of Meta kaolin and by products. The main reason for the current exploration is to accurately assess Rice husk ash, Fly ash (FA) and Glass Fiber powder

(ESP) chemically, physically and miner logically differentiated, to explore the feasibility of their employment as a cement-substituting material in the concrete industry.” Meta kaolin obtain from/local suppliers. "Rice husk ash is manufactured Pozzolanic mineral admixture which significantly enhances many performance characteristics of cement-based mortars, concrete and related products. The use of Pozzolanic materials in the manufacture of concrete has a long, successful history. Most pozzolans used in the world today are by products from other industries, such as coal flash, blast furnace slag, rice husk and silica fumes. "Metakoline is a dehydroxylated form of the clay mineral kaolinite. Rocks which have more akaolinite are known as china clay or kaolin, area used traditionally in the manufacture of porcelain The particle size of Metakoline is smaller than cement particles, but not as fine as silica fume." The supplementary pozzolanic agent from agriculture by-products like by products (RHA) are emerging as hot topics of incessant research. By products has high silica substance in the shape of non-crystalline. The top layer is a vertical layer covered by the organic cuticle. The eggshell has calcium, magnesium carbonate (lime) and protein. In many countries, it is the accepted practice for eggshell that first it is drying and then it is using as a source of calcium in animal feeds. For this study I collected broken Glass Fibers from college canteen and outside restaurants. First the shells boiled in water to clean from other materials and dried it in air for four days approximately at a temperature range of 25-300C. Then I crushed it by hand, grinded and sieved through 90µm. materials passed through 90µm sieve was used for cement replacement." The present report deals with the effects of mineral admixtures, by partial replacement of cement, in terms of improved performance on compressive strengths. First the Experimental work was carried out to investigate the effect of Glass Fiber powder by partial replacing cement and keeping same water cement ratio.

OBJECTIVES

The most important objectives of this study are

1) To study the relative strength development with age of (ESP) concrete, with control concrete."
2) In the present experimental investigation is to find the influence of By products(RHA) and Glass Fiber(GFB) on strength properties of concrete. By products(RHA)is used as partial replacement of cement and Glass Fibers (GFB) are added as supplement.
3) This work focuses experimental investigation, the cement is partially replaced by Byproducts(RHA) and Glass Fiber(GFB) carried out to study the effects of replacement of cement (by weight) with (5%, 10%, 15%,20%). By products(RHA) and the effects of addition of (0.5%, 1%, 1.5%) Glass Fiber composite.
4) The influence of combined application of By products(RHA)and Glass Fiber(GFB) on Mechanical properties of M40 grade of concrete is investigated.
5) This work continues with testing of concrete specimens in replacement of By products(RHA) and addition of Glass Fiber(GFB),both mechanical and durability properties were tested i.e. compression, split tensile strength and flexural strength.
6) Use of industrialized waste in a positive way.
7) To protect the environment by utilizing waste properly

II. LITERATURE REVIEW

D.Chetan et.al. have been carried out research on an strength characteristics by partial replacement of RHA and robosand in concrete. In this study the concrete is prepared by replacing fine aggregate with robosand in different proportions like 0%, 10%, 25%, 50%, 75%, and 100% and R.H.A as partially substitute material for cement in different proportions like 0%, 5%, 10%, 15%, and 20%. It was concluded that the compressive and tensile strength of concrete increases upto 3.12% and 5.63% but for robosand it is increased upto 5.8% and 19.63% after 28 days when fine aggregate is replaced by robosand. The optimum percentage of R.S replacement level in fine aggregate is 50%.The optimum percentage of R.H.A replacement level in ordinary Portland cement was 10%.

J.D.Chaitanyakumar et. al. have investigated experimental studies on glass fiber concrete. Addition of glass fiber will lead to gradual increase of compressive strength and workability. The compressive,tensile and split tensile strengths are very high at 1% for 7 days are 20.76 N/mm^2 ,1.47N/mm^2,2.83N/mm^2 and for 28 days,28N/mm^2,2.94N/mm^2,3.92N/mm^2.

Mahmoud MazenHilles,MohammedM.Ziara et.al. have carried out research on mechanical behaviour of high strength concrete reinforced with glass fibers. Concrete with various mixtures of AR-GF like 0.3%,0.6%,0.9,1.2% by weight of cement were prepared. The experimental results showed that the compressive, tensile and flexural strength are increased when compared to normal concrete.

Josephine cheung et. Al. wrote a review on admixtures and sustainability. This study mainly aims about the improvement that is derived from enhancing durability and strength through water reduction, and catalyzing the cement hydration process to enable replacement of clinker with supplementary cementitious materials. Naphthalene sulphonate formaldehyde condensate was applied during construction of road in masachusetts to darken the center line passing.

MortezaMadhkhan , Roozbehkatirai(2019) wrote a review on the effect of pozzolaic materials on mechanical properties and aging of glass fiber reinforced concrete.Different percentages of pozzolanic materials were used to prevent the corrosion of glass fiber.It was that the addition of glass fibers would partial lead to decrease compressive strength and improve modulus of rupture and toughness index.It was found that the modulus of rupture in GFRC revealed that the specific strength of cement declined within 7-90 days.

III. MATERIALS AND METHODOLOGY

Materials:

The following materials are being used and are listed below.

- CEMENT
- BY PRODUCTS (RHA)
- GLASS FIBER (GFB)
- FINE AGGREGATE
- COARSE AGGREGATE
- WATER
- SUPER PLASTICIZER

In the present study from the above mix design, we have choosen the following cases for casting

DESIGNATIONS M40 FIBRE REINFORCED CONCRETE

Mix (%)	Cement (Kg/m³)	By products(Kg/m³)	Fine aggregate (Kg/m³)	Coarse aggregate (Kg/m³)	Water (lit/m³)
R0	420	0	779	1182.08	151
R5	399	21	779	1182.08	151
R10	378	42	779	1182.08	151
R15	357	63	779	1182.08	151
R20	336	84	779	1182.08	151

IV EXPERIMENTAL INVESTIGATION

The following are the strength tests which was conducted in the project:

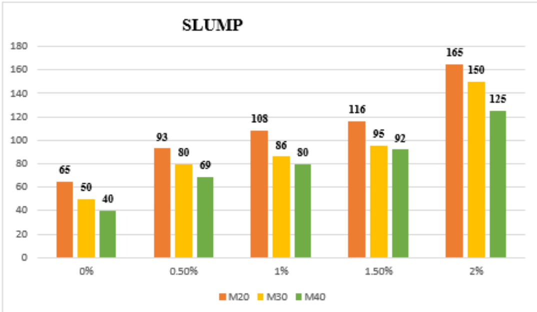
- Compressive strength test
- Split tensile strength test
- Flexural strength test

V RESULTS

The results completed in the present investigation are reported in the form of Tables and Graphs has carried out to study the effects of replacement of cement (by weight) with (5%, 10%, 15%,20%) By products (RHA) and the effects of addition of (0.5%, 1%, 1.5%) Glass Fiber (GFB) composite.

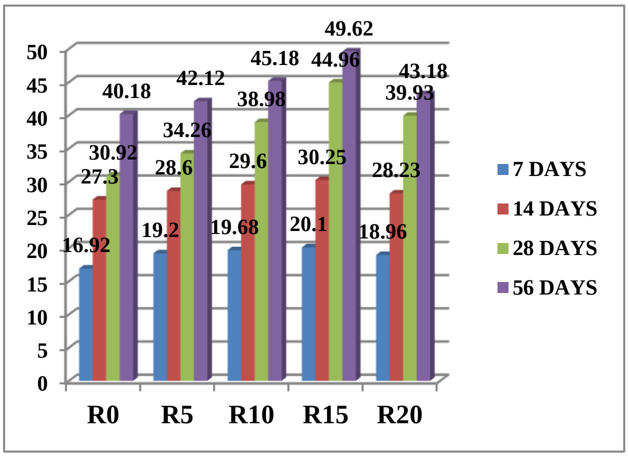
Slump test for self-curing concrete

S.No.	Mix id	0%	0.5%	1%	1.5%
1	R0	65	65	65	65
2	R5	72	80	95	69
3	R10	108	110	125	80
4	R15	123	135	148	105
5	R20	101	108	115	92



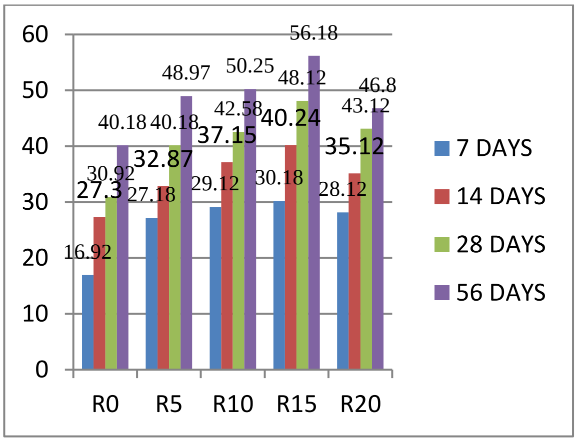
5.1 COMPRESSIVE STRENGTH OF CONCRETE WITH MIX DESIGN OF M40@ RHA(0%,5%,10%,15%,&20%)+GLASS FIBER(0%)

Mix id	7 DAYS	14 DAYS	28 DAYS	56 DAYS
R0	16.92	27.3	30.92	40.18
R	19.2	28.6	34.26	42.12
R10	19.68	29.6	38.98	45.18
R15	20.1	30.25	44.96	49.62
R20	18.96	28.23	39.93	43.18



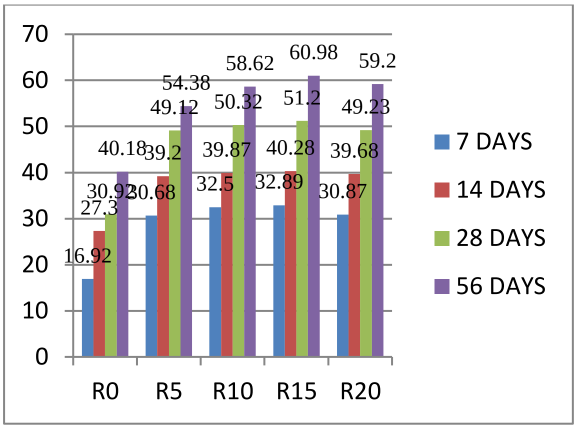
5.2 COMPRESSIVE STRENGTH OF CONCRETE WITH MIX DESIGN OF M40@ RHA(0%,5%,10%,15%,&20%)+GLASS FIBER(0.5%)

MIX ID	7 DAYS	14 DAYS	28 DAYS	56 DAYS
R0	16.92	27.3	30.92	40.18
R5	27.18	32.87	40.18	48.97
R10	29.12	37.15	42.58	50.25
R15	30.18	40.24	48.12	56.18
R20	28.12	35.12	43.12	46.8



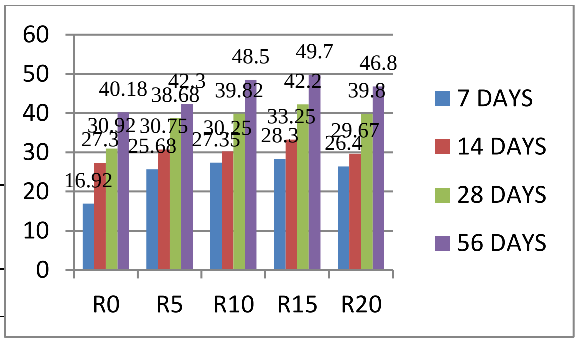
5.3 COMPRESSIVE STRENGTH OF CONCRETE WITH MIX DESIGN OF M40@ RHA(0%,5%,10%,15%,&20%)+GLASS FIBER(1%)

MIX ID	7 DAYS	14 DAYS	28 DAYS	56 DAYS
R0	16.92	27.3	30.92	40.18
R5	30.68	39.2	49.12	54.38
R10	32.5	39.87	50.32	58.62
R15	32.89	40.28	51.2	60.98
R20	30.87	39.68	49.23	59.2



5.4 COMPRESSIVE STRENGTH OF CONCRETE WITH MIX DESIGN OF M40@ RHA(0%,5%,10%,15%,&20%)+GLASS FIBER(1.5%)

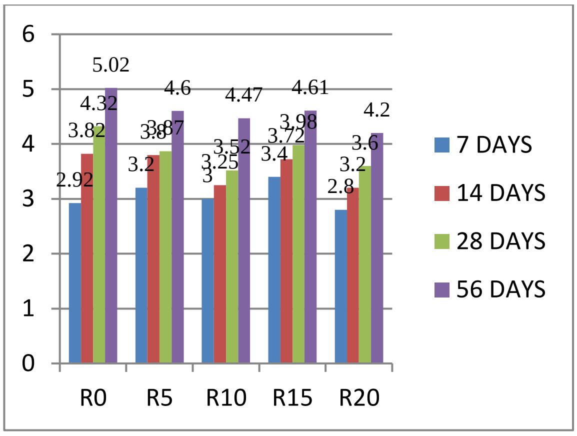
MIX ID	7 DAYS	14 DAYS	28 DAYS	56 DAYS
R0	16.92	27.3	30.92	40.18
R5	25.68	30.75	38.68	42.3
R10	27.35	30.25	39.82	48.5
R15	28.3	33.25	42.2	49.7
R20	26.4	29.67	39.8	46.8



SPLIT TENSILE STRENGTH TEST RESULTS

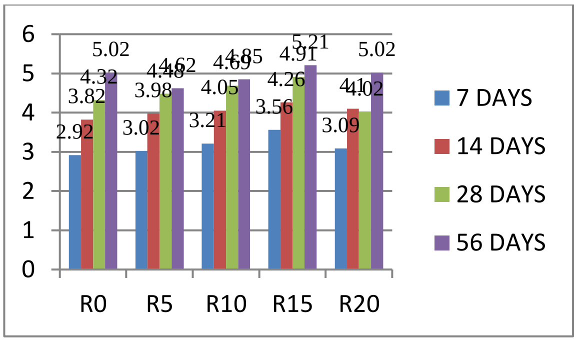
5.5 SPLIT TENSILE STRENGTH OF CONCRETE WITH MIX DESIGN OF M40 @ RHA(0%,5%,10%,15%,&20%)+GLASS FIBER(0%)

Mix id	7 DAYS	14 DAYS	28 DAYS	56 DAYS
R0	2.92	3.82	4.32	5.02
R5	3.2	3.8	3.87	4.6
R10	3.0	3.25	3.52	4.47
R15	3.4	3.72	3.98	4.61
R20	2.8	3.2	3.6	4.2



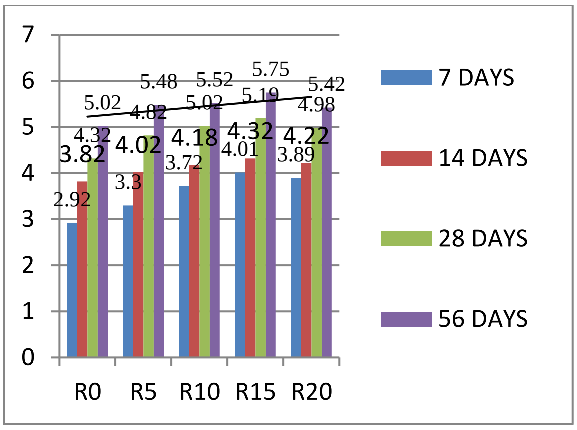
5.6 SPLIT TENSILE STRENGTH OF CONCRETE WITH MIX DESIGN OF M40 @ RHA(0%,5%,10%,15%,&20%)+GLASS FIBER (0.5%)

Mix id	7 DAYS	14 DAYS	28 DAYS	56 DAYS
R0	2.92	3.82	4.32	5.02
R5	3.02	3.98	4.48	4.62
R10	3.21	4.05	4.69	4.85
R15	3.56	4.26	4.91	5.21
R20	3.09	4.1	4.02	5.02



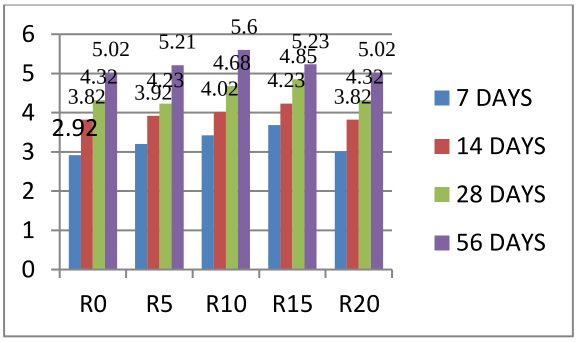
5.7 SPLIT TENSILE STRENGTH OF CONCRETE WITH MIX DESIGN OF M40@ RHA(0%,5%,10%,15%,&20%)+GLASS FIBER (1%)

Mix id	7 DAYS	14 DAYS	28 DAYS	56 DAYS
R0	2.92	3.82	4.32	5.02
R5	3.30	4.02	4.82	5.48
R10	3.72	4.18	5.02	5.52
R15	4.01	4.32	5.19	5.75
R20	3.89	4.22	4.98	5.42



5.8 SPLIT TENSILE STRENGTH OF CONCRETE WITH MIX DESIGN OF M40 @ RHA(0%,5%,10%,15%,&20%)+GLASS FIBER(1.5%)

Mix id	7 DAYS	14 DAYS	28 DAYS	56 DAYS
R0	2.92	3.82	4.32	5.02
R5	3.2	3.92	4.23	5.21
R10	3.42	4.02	4.68	5.6
R15	3.68	4.23	4.85	5.23
R20	3.01	3.82	4.32	5.02

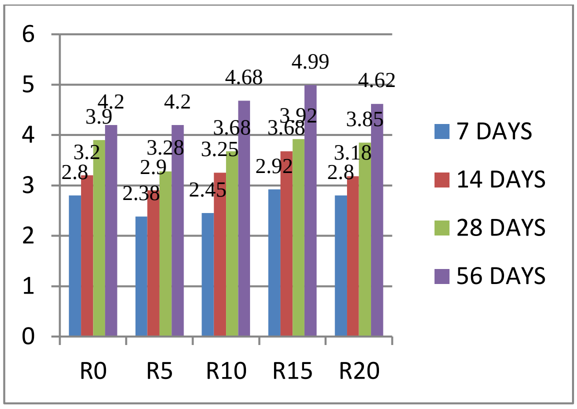


FLEXURAL STRENGTH TEST RESULTS

TABLE: 5.9. FLEXURAL STRENGTH OF CONCRETE WITH MIX DESIGN OF M40@ RHA(0%,5%,10%,15%,&20%)+GLASS FIBER (0%)

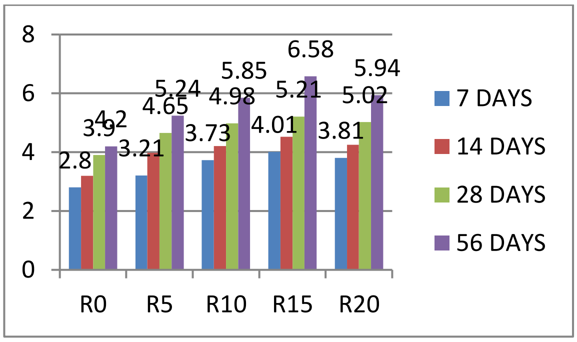
Mix id	7 DAYS	14 DAYS	28 DAYS	56 DAYS
R0	2.8	3.2	3.9	4.2
R5	2.38	2.9	3.28	4.2

R10	2.45	3.25	3.68	4.68
R15	2.92	3.68	3.92	4.99
R20	2.8	3.18	3.85	4.62



5.10. FLEXURAL STRENGTH OF CONCRETE WITH MIX DESIGN OF M40 @ RHA(0%,5%,10%,15%,&20%)+GLASS FIBER((0.5%)

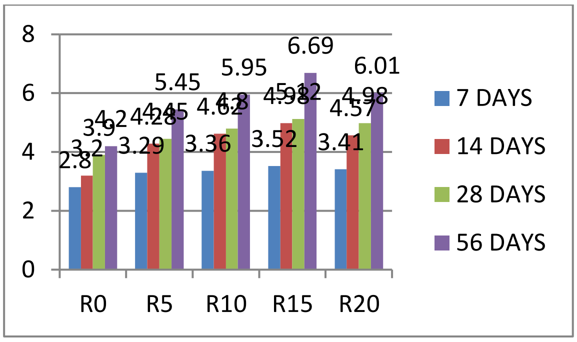
Mix id	7 DAYS	14 DAYS	28 DAYS	56 DAYS
R0	2.8	3.2	3.9	4.2
R5	3.21	3.98	4.65	5.24
R10	3.73	4.21	4.98	5.85
R15	4.01	4.52	5.21	6.58
R20	3.81	4.25	5.02	5.94



5.11. FLEXURAL STRENGTH OF CONCRETE WITH MIX DESIGN OF M40@RHA(0%,5%,10%,15%,&20%)+GLASS FIBER (1%)

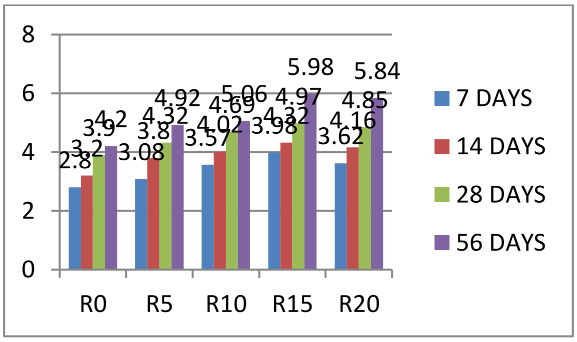
Mix id	7 DAYS	14 DAYS	28 DAYS	56 DAYS
R0	2.8	3.2	3.9	4.2
R5	3.29	4.28	4.45	5.45

R10	3.36	4.62	4.8	5.95
R15	3.52	4.98	5.12	6.69
R20	3.41	4.57	4.98	6.01



5.12 FLEXURE STRENGTH OF CONCRETE WITH MIX DESIGN OF M40@ RHA(0%,5%,10%,15%,&20%)+GLASS FIBER (1.5%)

Mix id	7 DAYS	14 DAYS	28 DAYS	56 DAYS
R0	2.8	3.2	3.9	4.2
R5	3.08	3.8	4.32	4.92
R10	3.57	4.02	4.69	5.06
R15	3.98	4.32	4.97	5.98
R20	3.62	4.16	4.85	5.84



VI. CONCLUSIONS

- The fiber in the cement byproducts-based matrix acts as crack- arresters, which restrict the growth of micro cracks andprevent these from enlarging under load.
- The experimental work has carried out to study the effects of replacement of cement (by weight) with (5%, 10%, 15%,20%). By products and the effects of addition of (0.5%, 1%, 1.5%) Glass Fiber composite.
- A M40 Grade of concrete is designed.
- This study reports the feasibility of use of Glass fibers, by products, super plasticizers, air entraining agents and accelerators content on structural properties such as compressive strength,split tensile strength, and flexural strength test.
- From the above compressive strength tests, it is concluded that the admixtures introduction increases strength follows from 0% to 15% further increment i.e., 20% gave decrement in strength so that 15% introduction of admixture gives optimum strength
- Glass Fiber Composite in the concrete mixtures from 0.5 to 1.5%, 1% gives optimum strength further decrement in compressive strength

- the above Split Tensile strength tests, it is concluded that the admixtures introduction increases strength follows from 0% to 15% further increment i.e., 20% gave decrement in strength so that 15% introduction of admixture gives optimum strength
- Glass Fiber Composite in the concrete mixtures from 0.5 to 1.5%, 1% gives optimum strength further decrement in Tensile strength
- From the above Flexure strength tests, it is concluded that the admixtures introductionincreases strength follows from 0% to 15% further increment i.e., 20% gave the decrement in strength so that 15% introduction of admixture gives optimum strength.Glass Fiber Composite in the concrete mixtures from 0.5 to 1.5%, 1% gives optimum strength further decrement in Flexure strength.

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