

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 3, March 2019

Experimental Investigation on Concrete Using Recron Fibre as Reinforcement

M.Prabu¹, I.Mohammedrafi², M.Sathees Kumar³

Assistant Professor, Department of Civil Engineering, P.A College of Engineering and Technology, Pollachi,
Tamilnadu, India^{1,2,3}

ABSTRACT: Fibre reinforced concrete is of high strength compared to normal concrete and also reduces the cracks due to shrinkage. In this investigation, Recron fibre is added to concrete in the proportion of 0%, 0.25%, 0.50%, and 1% by the weight of cement. This investigation is done in 4 different grades of concrete such as M20, M25, M30 and M35. For strength parameters, each grade of concrete for each proportion, cubes are casted for 7 days, 14 days and 28 days and prisms and cylinders are casted for 28 days. The compressive strength, flexural strength and split tensile strength are found and compared.

KEYWORDS: Fiber reinforcement, Recron fibre.

I. INTRODUCTION

Concrete is a composite material that consists essentially of a binding medium, such as a mixture of portland cement and water, within which are embedded particles or fragments of aggregate, usually a combination of fine and coarse aggregate. Concrete is by far the most versatile and most widely used construction material worldwide. It can be engineered to satisfy a wide range of performance specifications, unlike other building materials, such as natural stone or steel, which generally have to be used as they are. Because the tensile strength of concrete is much lower than its compressive strength, it is typically reinforced with steel bars, in which case it is known as reinforced concrete. Plain concrete possess a very low tensile strength, limited ductility and little resistance to cracking. Internal micro cracks are inherently present in the concrete and its poor tensile strength is due to the propagation of such micro cracks, eventually leading to brittle fracture of the concrete. It has been recognised that the addition of small, closely spaced and uniformly dispersed fibres to concrete would act as crack arrester and would substantially improve its static and dynamic properties. This type of concrete is known as Fibre Reinforced Concrete. Fibre Reinforced Concrete is the composite material containing fibres in the cement matrix in an orderly manner or randomly distributed manner. Its properties would obviously, depend upon the efficient transfer of stress between matrix and the fibres, which is largely dependent on the type of fibre, fibre geometry, orientation of fibres, mixing and compaction techniques and size of aggregate. Our main aim is to increase the strength of the concrete by adding recron fibre to it. Many studies have proven that using recron fibre in concrete will increase the strength of concrete.

II. LITERATURE REVIEW

Overviews of different studies on recron fibre in concrete have been listed as follows. S. Prem Kumar[1] studied Polyester FRC. In this study, Recron 3s fibre is added as an additive to the concrete. This fibre is added as 1%, 2% by the weight of fine aggregate in order to improve its performance. The Compression strength, split tensile strength and flexure strength of M25, M60 and M80 grade concrete are tested for 14, 28 and 56 days of curing and compared to find the optimum dosage of Recron 3s. 1% Recron 3s in concrete provided better results than 2% Recron 3s in concrete. Korrapati Anil Kumar [2] studied the strength properties of concrete with Recron 3s fibre in proportions of 0%, 0.2%, 0.3% and 0.4% for M25 and M40 grade concrete cubes, cylinders and prisms. The investigation is to study the workability parameters of M25 and M40 grades of concrete using slump cone test, Compaction factor test, and Vee-bee time test. For strength parameters, each grade of concrete for each proportion, cubes, cylinders, prisms were casted for

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 3, March 2019

7days, 28days, 56days and 91 days strength. The Recron fibre of 0.3% showed better results for M25 and M40 grades of concrete. Rakesh Kumar [3] discussed the effects of polypropylene fibre on the properties of a paving grade concrete mix of 48 MPa compressive strength at 28 days. Six concrete mixes with fibre dosages 0.05%, 0.10%, 0.15% by volume fraction besides the control concrete mix were manufactured. The study suggested a significant reduction in settlement and drying shrinkage without significant change in compressive strength for the concrete mixes reinforced with fibre. V.Prahatheswaran [4] studied comparison of Recron 3s fibre reinforced concrete elements with the conventional concrete specimens. Recron 3s fiber reinforced specimens having different fiber -volume fractions will be investigated. The parameters of investigation include compressive strength, split tensile strength and flexural strength. The specimens will be incorporated with 0.5 and 1% volume fraction of Recron 3S fibers in different proportions. It was found that both the compressive strength and the split tensile strength of the Recron 3S fiber reinforced concrete are more than that of the conventional concrete specimens.

Ridha Nehvi [5] describes the enhancement in the strength of the M35 grade concrete mix by the addition of Polypropylene fibres (recron 3S) in the proportion of 0.0%, 0.1%, 0.2%, 0.3%, 0.4%, and 0.5% by volume of concrete. Compressive strength, split tensile strength and flexural strength were carried on hardened concrete. Recron 3s showed improved tensile strength of concrete from 2.65MPa to 3.4MPa and flexural strength from 5.13MPa to 6.83MPa after 28 days of curing. Increase in concentration of recron 3s beyond 0.3% showed decline in flexural strength from 6.83MPa to 5.7MPa. Mohammed Safiuddin [6] compared Fibre Reinforced Concrete with the Plain Cement Concrete. Recron 3s at various dosages of 0.25%, 0.50%, 0.75% and 1.00% by weight of cement in the mix design is studied to find the optimum dosage of Polyester fiber for concrete. The strength of concrete increased for 0.25%, 0.5% and 0.75% and the strength decreased when the Recron fibre was increased to 1%. Liang Huang [7] done an experimental study of polyester fibre reinforced polymer confined concrete cylinders. This paper presents the results of an experimental investigation on the compressive behavior of concrete confined by polyester FRP jackets with low strength and high ductility. Test results indicated that the PFRP jacket confinement increased the ductility of concrete to a great extent. Dr. Vagheesha [8] studied the effects of Polyester fibre on concrete. This work deals with results of experimental investigation of effect of use of Recron 3S polyester fiber on compressive strength of concrete. This has resulted into casting, curing and testing of 27 cube specimen of size (150 x 150 x 150) mm. Recron 3s of 0.2-0.4% by weight of cement is sufficient for getting better compressive strength of concrete.

Kolli.Ramujee [9] studied the strength properties of Polypropylene fibre reinforced concrete. The compressive strength, splitting tensile strength of concrete samples made with different fibres amounts varies from 0%, 0.5%, 1%, 1.5% and 2.0% were studied. The samples with added Polypropylene fibres of 1.5 % showed better results in comparison with the others. A. P. Sathe [10] This paper presents research work of experimental investigation on polypropylene fiber reinforced concrete by replacing river sand to artificial sand with and without admixture. This paper presents the effect of polypropylene (PP) fibers on various properties of concrete such as compressive strength, tensile strength, workability, and fracture properties with various content of fiber(0% ,0.5%,1.0%,1.5%). The result of this present investigation indicates that by adding of 0.5% of polypropylene fiber shows maximum compressive and tensile strength. Damyanti G Badagha [11] studied Polyester Fibre Reinforced mortar as a cement concrete pavement material. Specimens containing fibre of 0.0, 0.3, 0.4, 0.5, 0.6, 0.8 and 1.0 % are prepared and tested. It is demonstrated that certain amount of fibres enhances the compressive as well as split tensile capacity of the fibre reinforced cement mortar. The Compressive strength of mortar was increased to 17.68 % at 7 days and Split tensile strength was increased by 32.58 % at 7 days and 70.37 % at 28 days. Machine Hsie [12] used polypropylene hybrid fiber for making concrete. It was reported that the compressive strength, split tensile strength and flexural strength properties of concrete with polypropylene hybrid fiber was better than that of the single fiber reinforced concrete. In addition, hybrid fibers disperse throughout concrete, so it can decrease drying shrinkage strain.

The aim of this study was to evaluate the use of cement concrete with fibre to achieve the desire needs. And to compare compressive strength, flexural strength and split tensile strength of plain cement concrete with fibre reinforced concrete also with various mix ratios. However, the mainstream of this investigation has been on concrete cubes, cylinders and prism with addition of recron fibre as reinforcement with various concrete design mix of M20, M25, M30 and M35, subjected to concentric compressive loading. The results are discussed in detail in this paper.

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 3, March 2019

III. MATERIAL PARAMETERS

The cross sections of the specimens in this investigation can be categorized. For this investigation totally 60 concrete cubes were casted of size 150 mm x 150 mm x 150 mm , 20 concrete cylinders of size 150 mm diameter and 300 mm long and 20 prism specimens of size 100 mm x 100 mm x 500 mm.

Cement

For this investigation Portland Slag Cement (PSC). It is obtained by mixing Portland cement clinker, gypsum and granulated blast furnace slag in suitable proportions and grinding the mixture to get a through and intimate mixture between the constituents. The resultant product is cement which has physical properties similar to those of Ordinary Portland Cement. In addition, it has low heat of hydration and is relatively better resistant to chlorides, soils and water containing excessive amount of sulphates or alkali metals. The 43 grade Portland Slag Cement confirming to IS 455-1989 is used. The physical characteristics of 43 grade PSC are listed below:

Table: 1 Physical properties of cement

Fineness (m ² /kg)	225
Soundness by Le chatlier (mm)	10
Soundness by Autoclave (%)	0.8
Initial setting time (min)	30
Final setting time (min)	600
Compressive Strength (28 days)	33
Specific Gravity	3-3.15
Fineness (m ² /kg)	225
Soundness by Le chatlier (mm)	10

Fine Aggregates

Manufactured sand (M-sand) is used as an alternative for river sand. Due to the depletion of good quality river sand for the use of construction in Tamilnad, the use of manufactured sand has been increased. Another reason for use of M-Sand is its availability and transportation cost. Since manufactured sand can be crushed from hard granite rocks, it can be readily available at the nearby place, reducing the cost of transportation from far-off river sand bed. Thus, the cost of construction can be controlled by the use of manufactured sand. The other advantage of using M-Sand is, it can be dust free, the sizes of m-sand can be controlled easily so that it meets the required grading for the given construction. It does not contain organic and soluble compound that affects the setting time and properties of cement, thus the required strength of concrete can be maintained. The fineness modulus of the fine aggregate used in this investigation is 2.6 confirms grading zone – II.

Coarse Aggregates

Concrete can be considered to be an artificial stone obtained by binding together the particles of relatively inert fine and coarse material with cement paste. The aggregate is used primarily for the purpose of providing bulk to the concrete. The aggregates most of which are retained on the 4.75 mm IS sieve and contained only that much of fine material as is permitted by the specifications are termed coarse aggregates. The coarse aggregates may be crushed gravel, uncrushed gravel or partially crushed gravel. The graded coarse aggregate is described by its nominal size, i.e., 80mm, 40 mm, 20mm, 16mm and 12.5mm. The properties of aggregates such as chemical and mineral composition, specific gravity, hardness, strength and colour have a considerable effect on the quality of concrete in fresh and hardened states. Here we use coarse aggregate maximum size of 20 mm with fineness modulus 2.96.

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 3, March 2019

Water

Water is the next most important ingredient after cement for making concrete. It is also the least expensive. Careless use of water can lead to poor quality concrete. Therefore, a detailed study of the quality and quantity of water required for making good quality concrete is essential. Water used for mixing and curing should be free from oil, acid and alkali, salts, and organic material. The pH value of the water must lie between 6 and 8. It should be of portable quality and generally purer than that required for drinking. Whenever there is uncertainty of quality, water should be tested before use. Certain chemicals which are sometimes found in water source may cause long term durability problems that take years to develop.

Concrete

The mix design of concrete is in accordance with Indian standard code. The coarse aggregate was well graded with maximum size of 20 mm were used, the fine aggregate was river sand with fineness modulus 2.60. Mix proportion of cement, fine aggregate, coarse aggregate of different grades such as M20, M25, M30 and M35 of mix proportion 1:1.6:3.6, 1:1.5:3.2, 1:1.33:2.87, 1:1.1:2.4 with a water cement ratio of 0.55, 0.5, 0.45 and 0.4 are used. All concrete specimens were cast from the similar delivery of materials (m-sand, coarse aggregate and cement) and of the same kind casting and curing procedures were adopted throughout the test program. A standard cube tests were used to determine the compressive strength of the concrete.

Recron fibre

Reliance Industry Limited (RIL) has launched Recron 3s fibre with the objective of improving the quality of concrete. The Recron fibre spread across entire section, when used in low dosage and also arrests cracking in concrete. Recron 3s is a state of art reinforcing material which is used to increase the strength in variety of applications like automotive battery, paper, filtration fabrics, asbestos cement sheets, cement based pre-cast products and for improving quality of construction. Recron 3s fibre has a triangular cross section with cut length of 6, 12 or 18 mm which is being widely used in the Indian Construction industry market. At a specified dosage of 0.25% by weight of cement there are millions of fibres which form a three dimensional mesh in the concrete. The spacing is approximately less than 1mm between any two fibre filaments in any coordinate of the matrix thereby improving the mechanical properties.

Table: 2 Properties of recron fibre

Fiber type	Polyester CT2424
Effective Diameter	20-40 μ
Specific gravity	1.34-1.39
Melting point	250-265 Deg.c
Elongation	20-60%
Alkaline stability	Very good
Acid resistance	Excellent
Dispersion	Excellent
Soundness by Le chatlier (mm)	10

Direction of use (recron fibre)

Sprinkle the fibre in site mixer with little water. Keep rotating and add chips, sand, cement and balance water. Mix it for a few minutes. In case of manual mixing, for best results mix half the fibre in a bucket of water, stir well and mix in mortar. Likewise add balance fibre. Recron 3s is meant for improving the quality of construction, savings on wastage and for speeding up the work place. Recron 3s is meant for secondary reinforcement only.

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 3, March 2019

Abrasion/ Impact resistance approvals of recron fiber

Recron 3s FRC has been approved by various governments, semi government, private and Industrial Projects. It has been approved by Airport Authority of India, Military Engineer Services and State PWD Schedule of Rates (Maharashtra, Gujarat, Rajasthan, J&K, Punjab)



Fig. 1. Recron fibre



Fig. 2. Mixing of recron fiber

IV. EXPERIMENTAL INVESTIGATION

In this study, the production of concrete for this test was conducted at the concrete. All preparation of concrete was undertaken in accordance with IS10262-2009. Total of 60 cube specimens were casted in which twelve specimens were casted for M20, M25, M30 and M35 grades of concrete for zero percentage replacement of recron fibre, twelve specimens were casted for the above different grades of concrete for 0.25% replacement of recron fibre, twelve specimens were casted for the above different grades of concrete for 0.5% replacement of recron fibre, rest of cube specimens were casted the above different grades of concrete for 0.1% replacement of recron fibre. Also twenty concrete cylinder specimens and twenty concrete prism specimens are casted for the same 0%, 0.25%, 0.5% and 0.1% of partial replacement of recron fiber by the weight of cement. These casted specimens were then removed from the moulds and were marked with their respective designations and placed in the curing tank which is filled with clean water. The specimens were removed from water after 7 days, 14 days and 28-days and were tested to obtain the compressive strength, split tensile strength flexural strength results.

Compressive Strength test

The cubes of size 150x150x150mm are placed in the machine such that load is applied on the opposite side of the cubes as casted. Align carefully and load is applied, till the specimen breaks.

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 3, March 2019

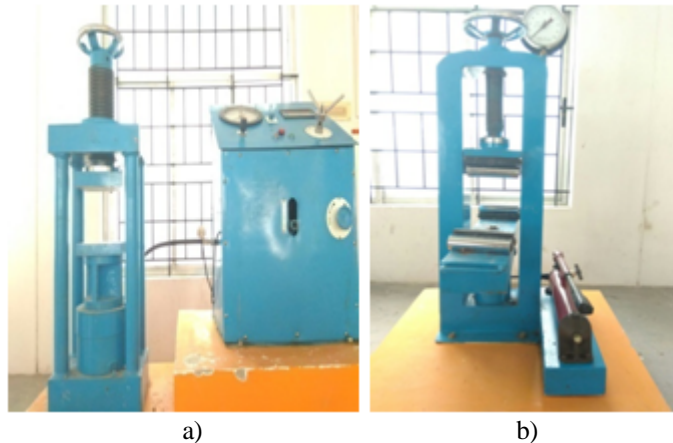


Fig. 3. a) Compression testing machine, b) Flexural testing machine

Split Tensile Test

The test is carried out by placing cylinder specimen of dimension 150mm diameter and 300mm length, horizontally between the loading surface of compression testing machine and the load is applied until failure of the cylinder along the vertical diameter. The failure load of the specimen is noted.

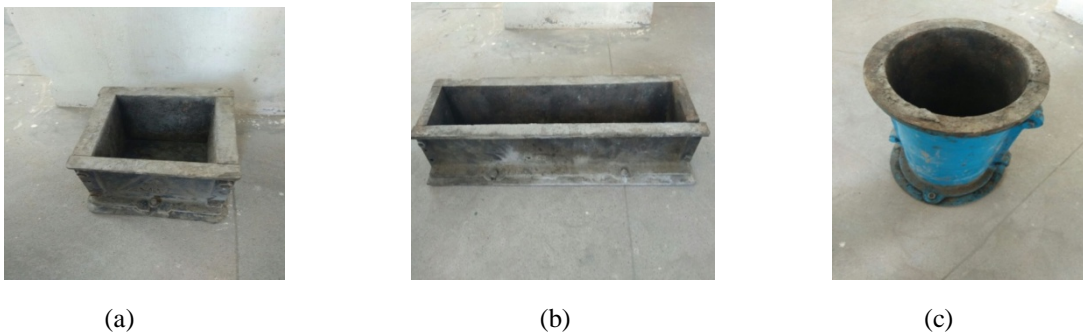


Fig. 3. a) Cube mould, b) Prism mould, c) Cylinder mould

Flexural Strength Test

The test is carried out to find the flexural strength of the prism of dimension 100 x 100 x 500 mm. The prism is then placed in the machine in such manner that the load is applied to the uppermost surface as cast in the mould.



Fig. 4. a) Casting of specimens, b) Curing of specimens

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 3, March 2019

V. EXPERIMENTAL RESULTS

The average compression strength, split tensile strength and flexural strength of casted cubes was determined as per IS 516-1959 using partial replacement of recron fibre at the age of 7, 14 and 28 days and reported in Table 3-5. Variation of compressive strength of all the mixes cured at 7-days 14-days and 28-days is also shown in Table 3-5 also in Fig 2-9.

Table: 3 Compressive strength test result

Addition of Recron fiber %	Compressive Strength (N/mm ²)											
	M20 Grade			M25 Grade			M30 Grade			M35 Grade		
	7 Days	14 Days	28 Days	7 Days	14 Days	28 Days	7 Days	14 Days	28 Days	7 Days	14 Days	28 Days
0	12.4	18.6	23.7	15.82	23.5	30.04	18.93	27.6	31.30	23.00	33.64	37.28
0.25	13.04	19.42	25.28	18.08	24.13	31.24	20.5	29.56	32.93	23.5	35.38	38.58
0.50	13.80	20.04	25.78	19.15	25.6	32.49	21.06	30.13	33.60	24.3	36.13	39.20
0.75	14.44	20.8	26.71	20.32	26.8	34.09	22.2	31.2	34.67	25	36.76	39.90
1	13.80	19.5	25.91	18.70	26.17	32.84	21.2	30.27	33.78	24.7	36.4	39.51

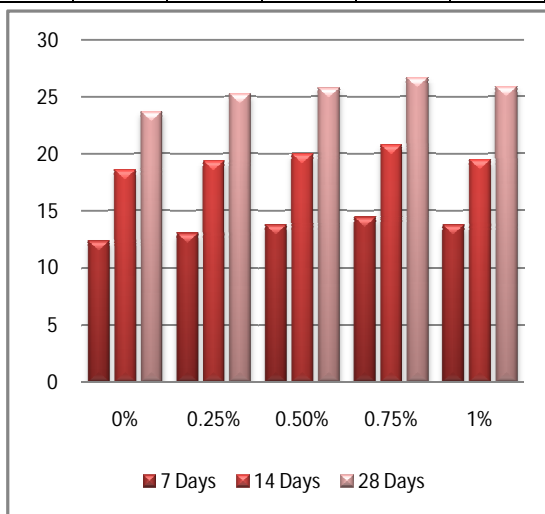


Fig. 5. Compressive strength of M20 grade concrete cubes specimens

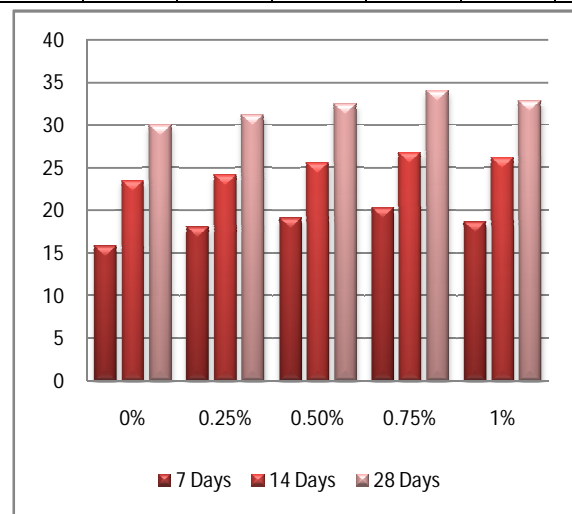


Fig. 6. Compressive strength of M25 grade concrete cubes specimens

Fig. 5 and 6 describes the compressive strength of M20 grade concrete cube specimens at the age of 7, 14 and 28 days .

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 3, March 2019

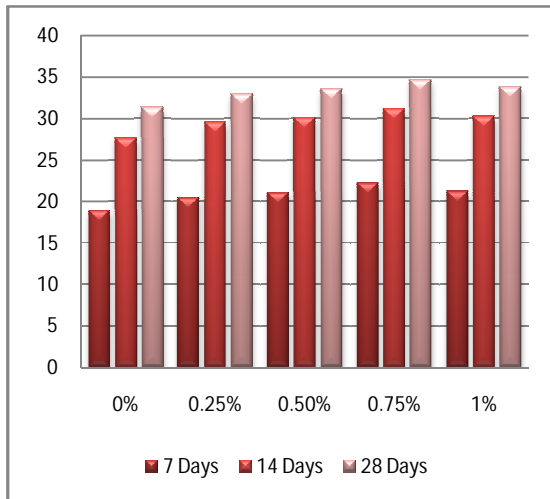


Fig. 7. Compressive strength of M30 grade concrete cubes specimens

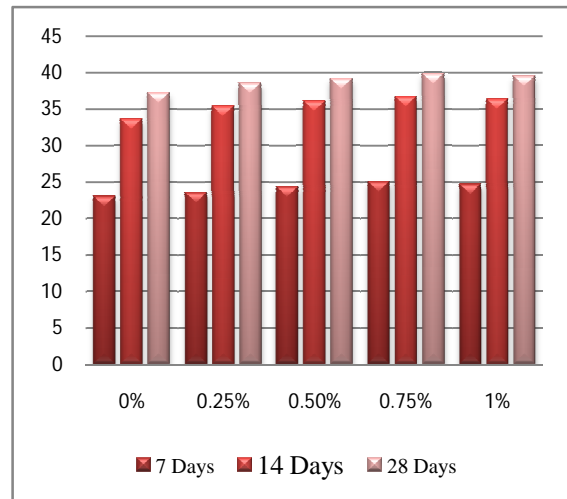


Fig. 8. Compressive strength of M35 grade concrete cubes specimens

Table: 4 Split tensile strength test result

Addition of Recron fiber %	Split Tensile Strength at 28 days (N/mm ²)			
	M20 Grade	M25 Grade	M30 Grade	M35 Grade
0	2.25	3.13	4.01	5.22
0.25	2.29	3.17	4.07	5.27
0.50	2.41	3.28	4.20	5.41
0.75	2.55	3.42	4.34	5.54
1	2.31	3.32	4.18	5.31

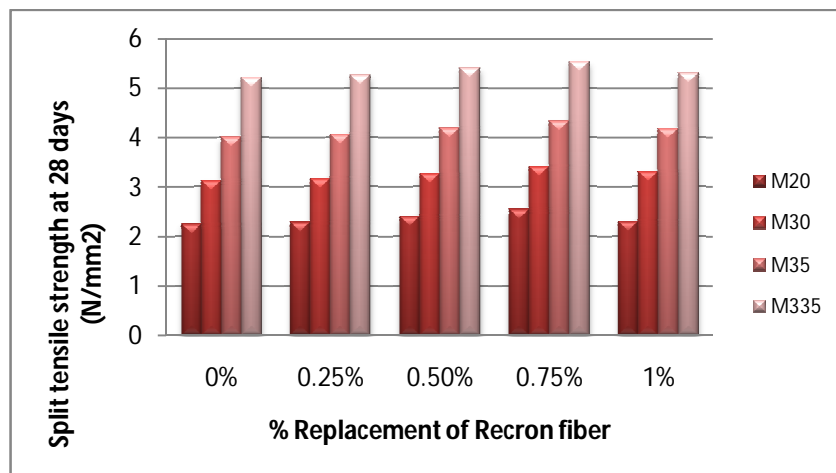


Fig. 8. Split tensile strength of concrete cylinder specimens

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 3, March 2019

Table: 5 Flexural strength test result

Addition of Recron fiber %	Flexural Strength at 28 days (N/mm ²)			
	M20 Grade	M25 Grade	M30 Grade	M35 Grade
0	3.11	4.85	5.79	6.81
0.25	3.19	4.93	5.87	7.03
0.50	3.40	5.16	6.18	7.38
0.75	3.96	5.57	6.68	7.69
1	3.53	5.23	6.27	7.41

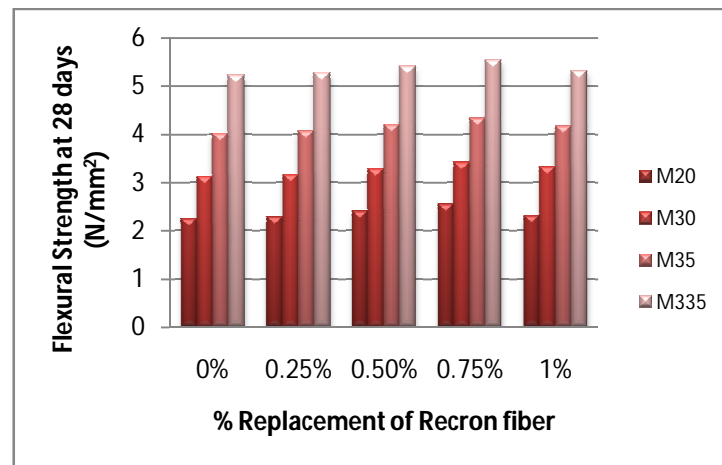


Fig. 9. Flexural strength of concrete prism specimens

VI. CONCLUSION

From the above experimental results, it is clear that the strength of concrete increases when recron fibre is added to it. It is found that the strength of concrete increases gradually from 0.25% and then decreases in 1% of recron fibre in concrete. M20, M25, M30, M35 grades of concrete showed better results for 0.75% of recron in concrete. The strength of all the four grades of concrete decreased when recron was increased to 1% in concrete. Better flexural strength was obtained when the recron fibre was increased to 0.75% by weight of cement in concrete. Split tensile strength increased from 0.25% to 0.75% of recron in concrete and decreased when 1% of recron was added to concrete. So, in order to get maximum strength, 0.75% of recron fibre by weight of cement can be added to concrete.

REFERENCES

- [1] S. Prem Kumar, A. J. Jeyarthi, "Experimental Investigation of Reinforced Concrete Using Recron 3s", International Journal of Latest Engineering and Management Research, Vol.02, pp.45-52, 2017.
- [2] Korrapati Anil Kumar, Dr. Shaik Yajdani, "Study on Properties of Concrete using Recron 3s Fibre", International Journal of Science Technology & Engineering, Vol.4, pp.54-62, 2017.
- [3] Rakesh Kumar Gupta, Mohd Ziaulhaq, "Study of Properties of Polypropylene- Natural fiber composite", International Research Journal of Engineering and Technology, Vol.4, pp.3507-3511, 2017.
- [4] V.Prahatheswaran, Dr.P.Chandrasekaran, "Study On Structural Behaviour Of Fiber Reinforced Concrete With Recron 3s Fibres", SSRG International Journal of Civil Engineering- (ICRTECITA-2017) – Special Issue, 2017.
- [5] Ridha Nehvi, Prashant Kumar and Umar Zahoor Nahvi, "Effect of Different Percentages of Polypropylene fiber (Recron 3s) on the Compressive, Tensile and Flexural Strength of Concrete", International Journal of Engineering Research & Technology, Vol.5, pp.124-130, 2016.
- [6] U. Bhavitha, Mohammed Safiuddin, "Study of Strength Properties of Polyester Fibre Reinforced Concrete", Journal for Research,

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 3, March 2019

- Vol.2, pp.12-16, 2016.
- [7] Huang, L., Yang, X., Yan, L., He, K., Li, H., & Du, Y. "Experimental study of polyester fiber-reinforced polymer confined concrete cylinders" Textile Research Journal, 86(15), pp.1606–1615, 2016.
 - [8] Dr. Vagheesha S. Mathda , Ms. Hemali K. Khaire, "Study of Effects of Polyester Fibers on Compressive Strength of Concrete", International Journal for Research in Applied Science & Engineering Technology, Vol.4, pp.53-56, 2016.
 - [9] Saman Khan P Roohul Abad Khan, Amadur Rahman Khan, Misbahul Islam, Saman "Mechanical Properties of Polypropylene Fibre Reinforced Concrete for M25 and M30 mixes: A Comparative study", International Journal of Scientific Engineering and Applied Science, Vol.1, pp.327-340, 2015.
 - [10] A. P. Sathe, A. V. Patil, "Experimental Investigation on Polypropylene Fiber Reinforced Concrete with Artificial Sand", International Journal of Science and Research, Vol.4, pp.1209-1213, 2015.
 - [11] Damyanti G Badagha, C D Modhera, "Studies on Harden Properties of Mortar Using Polyester Fibre", International Journal of Advances in Engineering & Technology, Vol.2, pp-42-46, 2013.
 - [12] Machine Hsie, Chijen Tu, P.S. Song, "Mechanical properties of polypropylene hybrid fiber- reinforced concrete", Materials Science and Engineering: A, Vol.494(1-2), pp: 153-157, 2008.