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To Study the Properties of Latex Modified Steel Fibre Reinforced Concrete

[1]Faraz Khan, [2]Juned Ahmad

[1]Post-Graduate Student, Department of Civil Engineering, Integral University, Lucknow, U.P., India
[2]Assistant Professor, Civil Engineering, Integral University, Lucknow, U.P., India

***Abstract*: This journal documents the effects of using steel fibres in Styrene Butadiene Rubber (SBR) latex modified concrete. The study was carried out to record the different properties of steel fibre reinforced latex modified concrete such as compressive strength, split tensile strength and flexural strength. Latex modified concrete is defined as Portland cement and aggregate combined at the time of mixing with polymers that are dispersed in water. This dispersion is called as latex. Polymer when used as an admixture can improve properties like higher strength and lower water permeability than the conventional concrete. Since, concrete is weak in tension, steel fibres have been added to concrete, to improve its characteristics in tension. The polymer concrete specimens with and without fibres and latex were cast and tested to watch the improvement of certain mechanical and physical properties like compressive strengths, tensile strengths, flexural strengths and workability. Styrene Butadiene Rubber Latex polymer and hooked end steel fibres have been used for our study. The percentage of steel fibre used were 0%,0.5%,0.75%,1%,1.25% at an interval of 0.25%. The fraction of steel fibre which gave the best result was taken and latex was varied in percentage 5%, 10%, 15% to obtain maximum strength. In all total 24 specimen cubes (150mm X 150 mm X 150 mm), 24 beam (500mm X 100mm X 100mm) and 24 cylinder specimens (150 mm X 300 mm) were made. The hardened properties of concrete were tested at 28th days.**

***Keywords:* Concrete, styrene butadiene rubber latex polymer, steel fibre, flexural strength, compressive strength, split tensile strength.**

1. INTRODUCTION

Concrete is a composite material composed mainly of water, aggregate, and cement mixed together to form a fluid mass that is easily moulded into various shapes. Over time, the cement forms a hard matrix which binds the rest of the ingredients together into a durable stone-like material with many uses. As times change, there is a need to provide better concrete, in terms of its strength, durability, etc. Special concretes need to be designed which are task specific. Certain fibres, polymers and admixture are used nowadays, to achieve the required concrete mixes.

The inclusion of steel fibre was first put forward by Porter in 1910, but little progress was made in its development till 1963.The weak matrix in the concrete, when reinforced with steel fibres, uniformly distributed across its entire mass, gets strengthened enormously, thereby rendering the matrix to behave as a composite material with properties significantly better from conventional concrete. Fibre Reinforced, new generation concrete, results from the addition of either short discrete fibres or continuous long fibres to the cement based matrix. Due to the superior performance characteristics of this concrete, its use by the construction industry has significantly increased. The type of steel fibre used in present study was round, carbon steel with hooked ends and an aspect ratio of 50 i.e. 30 mm length and 0.6 mm diameter.

The concept of polymer hydraulic cement is not new, and in 1923, the first patent was issued to Cresson. He patented the concept of paving materials with natural rubber latexes, and cement was used as filler. The first patent with the present concept of the polymer latex modified systems was published by Lefebvre in 1924. He was the first worker who intended to produce a latex-modified mortar and concrete using natural rubber latexes by a mix-proportioning method. A similar idea was patented by Kirkpatrick in 1925. For this study, Berger home shield SBR Latex polymer has been used.

2. EXPERIMENTAL PROGRAMME

2.1 Materials Used:

2.1.1 Cement

Ordinary Portland cement of brand Birla uttam and grade 43 conforming to IS standards has been procured and the properties of the cement are investigated in the laboratory. The specific gravity of cement is 3.15.

2.1.2 Fine Aggregate

The locally available river sand conforming to grading zone-III of IS 383-1970 has been used as Fine Aggregate. The various properties of fine aggregate used in present study are given in table 1.

Table 3.4 Physical Properties of Fine Aggregate:

Characteristics	Observed Values
Grading Zone	III
Fineness modulus	2.367
Specific gravity	2.61
Silt content	2%

2.1.3 Coarse Aggregate

The locally available crushed granite material has been used as coarse Aggregate. The coarse aggregate also confirms to IS 383-1970.

Table 3.7 Physical Properties of Coarse Aggregate:

Characteristics	Observed Values
Fineness modulus	1.844
Specific gravity	2.64

2.1.4 Steel Fibre

Steel fibre is kind of advanced composite material, which is most widely used for concrete reinforcing in construction and engineering work nowadays. Certain dosage of steel fibre in concrete can cause qualitative change on concrete's physical property, greatly increasing cracking resistance, impact resistance, fatigue resistance, bending resistance, tenacity, durability and other properties. The steel fibres generally used in concrete are made up of carbon steel and are manufactured in various shapes and sizes. Steel fibres mixed into the concrete can provide an alternative to the provision of conventional steel bars or welded fabric in some applications. In this investigation hooked end steel fibres have been used. The diameter of fibres is 0.6mm and the Aspect ratio is 50.

2.1.5 Styrene Butadiene Rubber Latex

Styrene-butadiene rubber (SBR), a general-purpose synthetic rubber, produced from a copolymer of styrene and butadiene. SBR is a mixture of approximately 75 percent butadiene (CH2=CH-CH=CH2) and 25 percent styrene (CH2=CHC6H5). In most cases these two compounds are copolymerized (their single-unit molecules linked to form long, multiple-unit molecules) in an emulsion process, in which a soap like surface-acting agent disperses, or emulsifies, the materials in a water solution. Other materials in the solution include free-radical initiators, which begin the polymerization process, and stabilizers, which prevent deterioration of the final product. Upon polymerization, the styrene and butadiene repeating units are arranged in a random manner along the polymer chain. The polymer chains are cross-linked in the vulcanization process. In the present study, Berger home shield SBR latex has been used.

2.1.6 Super Plasticizer

Super plasticizer is chemical admixtures used in high grade of concrete mainly to increase workability and reduce water content without affecting the strength of concrete. The super plasticizer used in the present study was Cico super plast HS which is based on specially selected high molecular weight organic polymers.

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2.1.7 Water

Clean potable fresh water, which is free from concentration of acid and organic substances, has been used for mixing the concrete.

2.2 Fabrication and Casting:

The moulds used for cubes, beams and cylinders were of steel having an internal dimension of 150 mm x 150 mm for cube, 100 mm x 100 mm x 750 mm for beam and 300 mm x 150 mm for cylinder. The cement, coarse and fine aggregate and superplasticizer were mixed thoroughly with the help of mechanical mixer. Then steel fibre is dispersed to the above mixture while mixer is working. SBR latex is mixed in water and is put into the mixture. For all test specimens, moulds were kept on table vibrator and the concrete was poured into the moulds in three layers by tamping with a tamping rod and the vibration was effected by table vibrator after filling up the moulds. The moulds are kept in vibration for one minute and it was maintained constant for all the specimens. The steel fibre is varied in a fraction of 0%, 0.5%, 0.75%, 1%, and 1.25%. The percentage at which maximum strength is obtained was taken to vary SBR latex in a percentage of 5%, 10% 15%. 3 cubes, 3 beams and 3 cylinder specimen are made for each set.

Mixing of Concrete by Mechanical Mixer

2.3 Curing:

The moulds were removed after 24 hours and the specimens were kept immersed in a clear water tank. After curing the specimens in water for a period of 28 days the specimens were removed out and allowed to dry under shade.

3. RESULTS

TABLE FOR COMPRESSIVE STRENGTH:

Variation of Steel Fibre:-

Steel Fibre Percentage	Average Compressive Strength at 28 Days (N/mm^2)
0.00%	35.99
0.50%	38.59
0.75%	35.59
1.00%	42.08
1.25%	37.67

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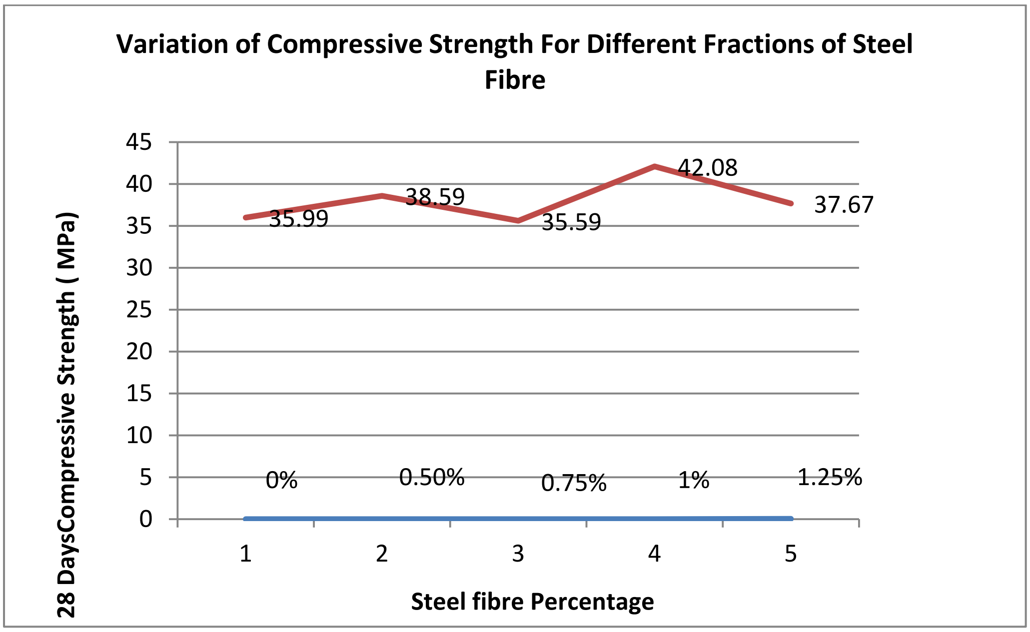

Variation of Steel Fibre + SBR Latex:-

Steel Fibre+ SBR Latex Percentage	Average Compressive Strength at 28 Days (N/mm^2)
1% Fibre + 5% SBR Latex	37.89
1% Fibre + 10% SBR Latex	43.88
1% Fibre + 15% SBR Latex	37.22

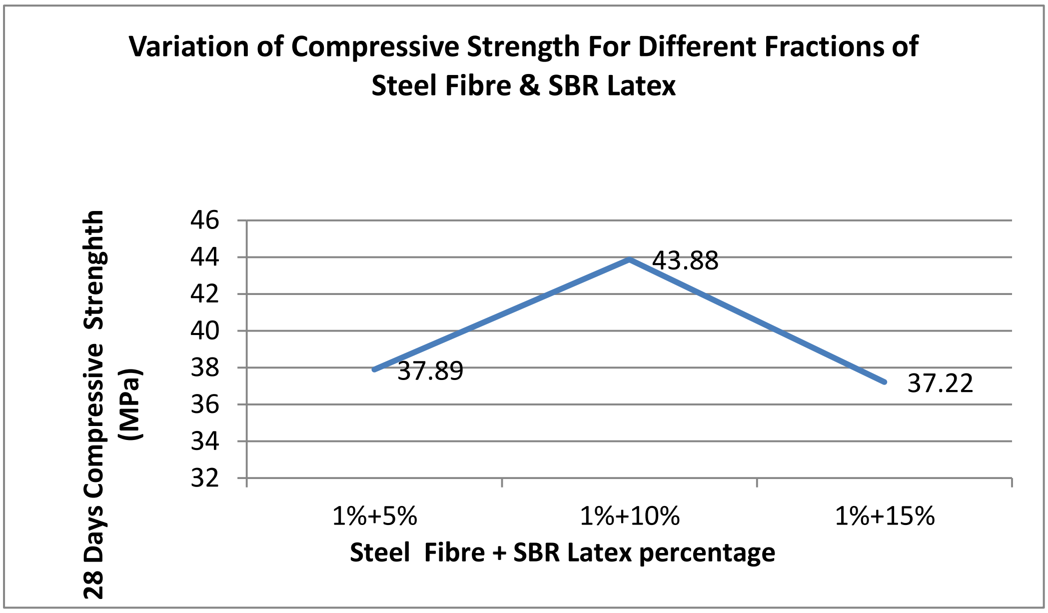

TABLE FOR SPLIT TENSILE STRENGTH:

Variation of Steel Fibre:-

Steel Fibre Percentage	Average Tensile Strength at 28 Days (N/mm^2)
0.00%	4.78
0.50%	5.38
0.75%	4.49
1.00%	6.05
1.25%	4.86

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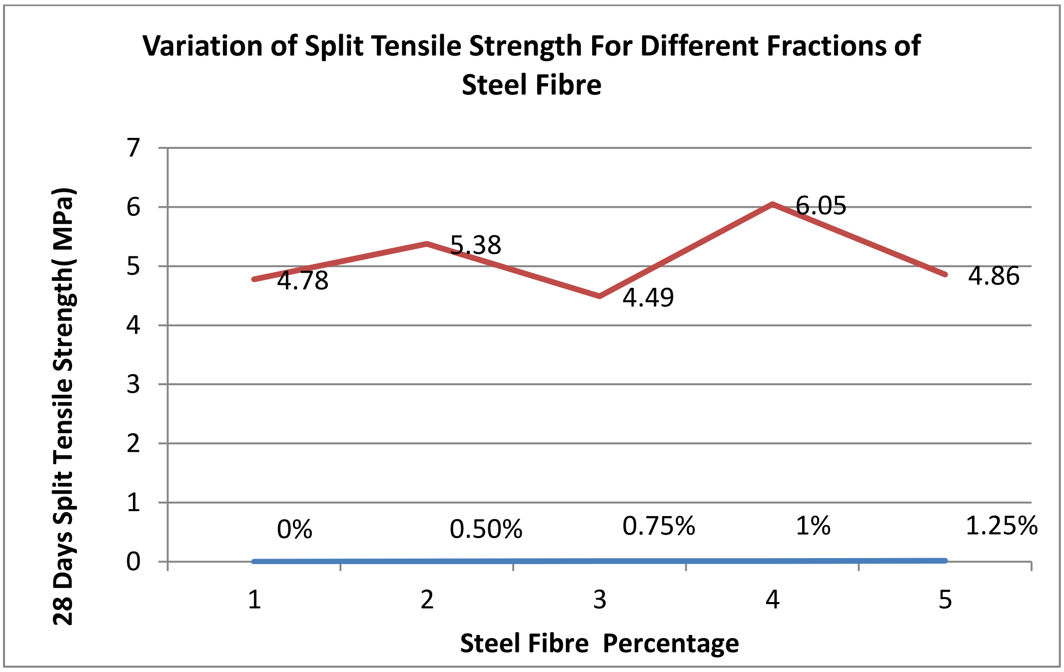

Variation of Steel Fibre + SBR Latex:-

Steel Fibre+ SBR Latex Percentage	Average Tensile Strength at 28 Days (N/mm^2)
1% Fibre + 5% SBR Latex	4.92
1% Fibre + 10% SBR Latex	6.60
1% Fibre + 15% SBR Latex	4.80

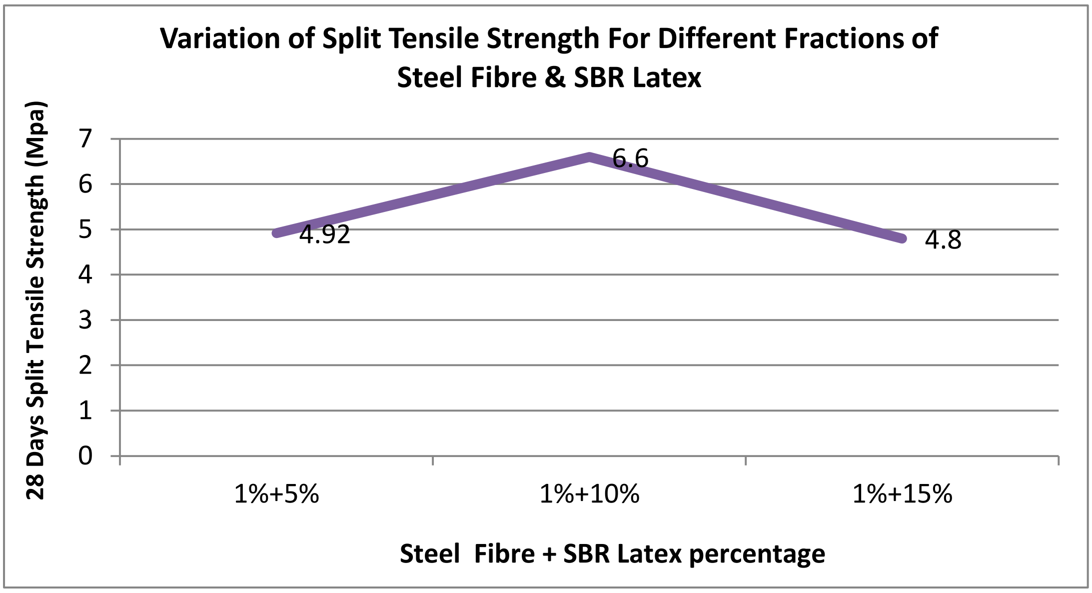

TABLE FOR FLEXURAL STRENGTH:

Variation of Steel Fibre:-

Steel Fibre Percentage	Average Flexural Strength at 28 Days (N/mm^2)
0.00%	12.23
0.50%	9.56
0.75%	12.68
1.00%	13.30
1.25%	13.00

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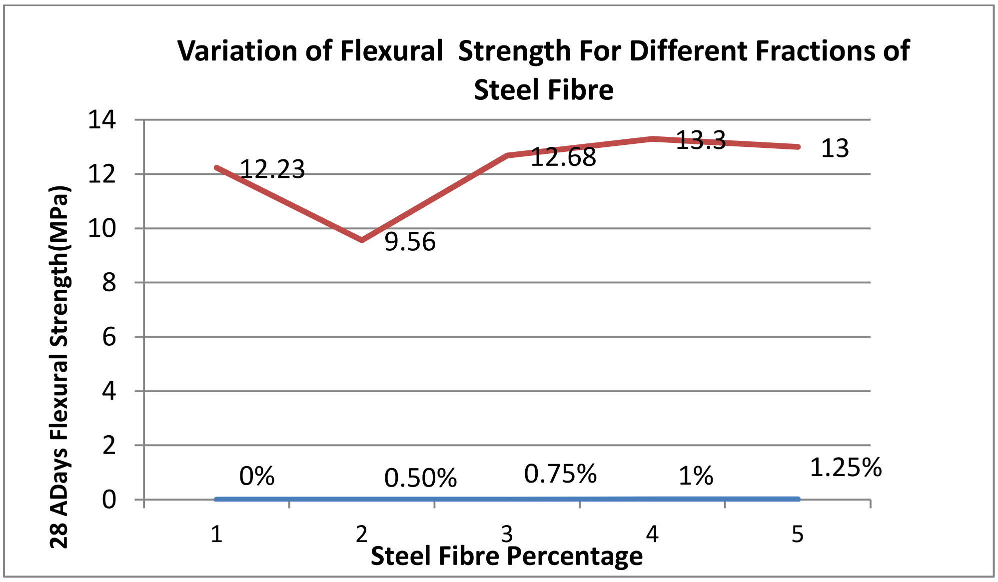
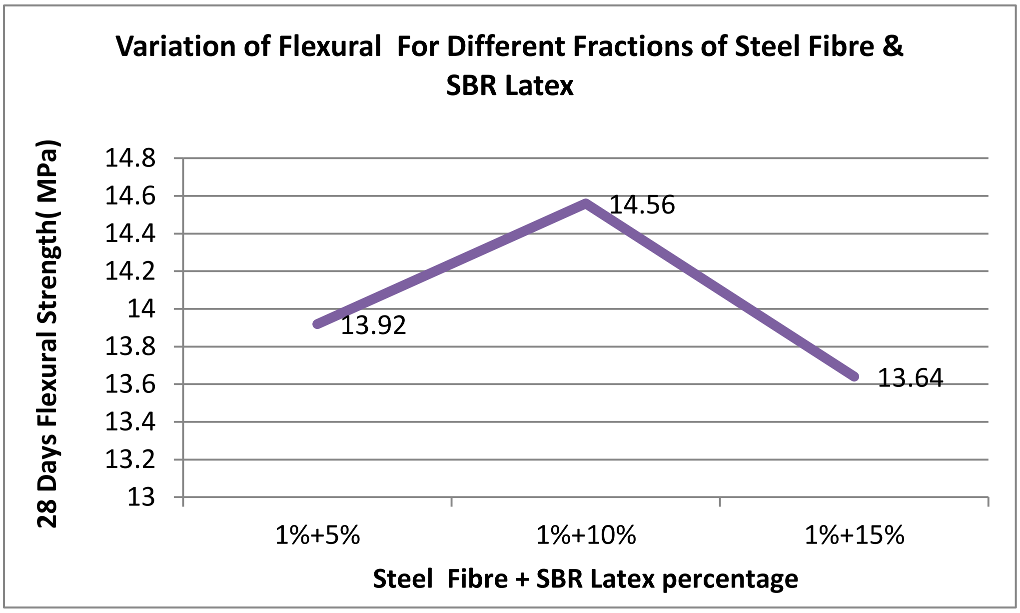


Variation of Steel Fibre + SBR Latex:-

Steel Fibre+ SBR Latex Percentage	Average Tensile Strength at 28 Days (N/mm^2)
1% Fibre + 5% SBR Latex	13.92
1% Fibre + 10% SBR Latex	14.56
1% Fibre + 15% SBR Latex	13.64



4. CONCLUSIONS

In the present study, the mechanical properties of three types of concrete namely plain concrete, steel fibre reinforced concrete and latex modified steel fibre reinforced concrete has been determined on the basis of various test results carried out in laboratory.

Based on these results and observations made in this experimental research study, the following conclusions are drawn:-

1. It has been found that compressive, split tensile and flexural strength have their maximum values for 1% steel fibre dosage among all fibre variations. The compressive strength is increased by 17.97%, split tensile strength by 26.56% and flexural strength by 3.58% when compared to their nominal strength. For any further increase in fibre content the values of strengths decrease gradually.

2. When SBR latex is added along with 1% steel fibre dosage, maximum strengths are obtained at 10% of latex. The compressive strength is increased by 23.01%, split tensile strength by 38.07% and flexural strength by 13.47% when compared to their nominal strength.

3. The test results show that by using 10% latex along with 1% steel fibre, the compressive strength increased by 4.27%, split tensile strength by 9.09% and flexural strength by 9.54% when compared to strength values for 1% fibre alone.

4. All the three types of strength values (flexural, compressive, tensile) decrease for any further increase in the quantity of latex above 10% dosage.

5. By the addition of SBR latex, there is an increase in the workability of concrete as the polymer content is increased.

6. The addition of fibre plays an important role in arresting, delaying and propagation of cracks.

REFERENCES

[1] IS 10262: 2009 Indian Standard Guidelines for Concrete mix design.

[2] IS 383: 1970 Indian Standard specifications for coarse and fine aggregate from natural sources for concrete.

[3] Tarannum Meraj, AK Pandey and BK Rao “Flexural behaviour of latex modified steel fibre reinforced concrete” CSIR-Central building research institute Roorkee.

[4] Kapil Soni, YP Joshi “Performance analysis of SBR Latex on cement concrete mixes” Sati Govt. Engineering College, Vidisha.

[5] Textbook on Concrete Technology by ML Gambhir.

[6] Kavita S Kene, Vikrant S Vairagade and Satish Sathawane, “Experimental Study on Behaviour of Steel and Glass Fibre Reinforced Concrete Composites”. Bonfring International Journal of Industrial Engineering and Management Science, Vol. 2, No. 4.

[7] Shivananda. K.P “Studies on polymer modified steel fibre reinforced concrete” Thesis. Department of Civil Engineering, Regional Engineering college Calicut, University of Calicut, 1998.

[8] Sivakumar.M.V.N, “Effect of Polymer modification on mechanical and structural properties of concrete”, January 2010.