To Study the Properties of Latex Modified Basalt Fibre Reinforced Concrete

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Abstract- *This journal documents the effects of using basalt fibres in Styrene Butadiene Rubber (SBR) latex modified concrete. The study was carried out to record the different properties of basalt fibre reinforced latex modified concrete such as compressive 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, basalt 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, flexural strengths and workability. Styrene Butadiene Rubber Latex polymer and basalt chopped fibres have been used for our study. The percentage of SBR latex used were 0%, 2%, 4%, 6%, 8%, 10%, 12% at an interval of 2%. The fraction of SBR latex which gave the best result was taken and basalt fibre was varied in percentage 0%, 0.25%, 0.5%, 0.75%, 1%, 1.25% to obtain maximum strength. In all total 36 specimen cubes (150mm X 150 mm X 150 mm) and 36beams (500mm X 100mm X 100mm) were made. The hardened properties of concrete were tested at 28th days.*

Keywords- Concrete, styrene butadiene rubber latex polymer, basalt fibre, flexural strength, compressive strength.

I. 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 weak matrix in the concrete, when reinforced with basalt 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 material used in the present study was basalt chopped fibre, 12 mm in length and Dr. Fixit Pidicrete URP SBR Latex Polymer.

II. EXPERIMENTAL PROGRAMME

2.1 Materials Used

2.1.1 Cement

Ordinary Portland cement of brand Prism 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.

Table 1 Physical Properties of Ordinary Portland Cement

Characteristics	Observed Values
Normal consistency	31 %
Initial setting time	73 minutes
Final setting time	425 minutes
Specific gravity	3.15
Compressive Strength at 28 days	43.2 Mpa

2.1.2 Fine Aggregate

The locally available river sand conforming to grading zone-IIof 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 2 Physical Properties of Fine Aggregate:

Characteristics	Observed Values
Grading Zone	II
Fineness modulus	2.73
Specific gravity	2.60
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 Physical Properties of Coarse Aggregate

Characteristics	Observed Values
Fineness modulus	6.865
Specific gravity	2.70

2.1.4 Basalt Fibre

Basalt fibre is a material made from extremely fine fibres of basalt. The manufacture of basalt fibre requires the melting of the quarried basalt rock at about 1,400 °C. It is a commonly known as a basalt roving or continuous filament fibre. It is cost effective, and anti-aging. Its colour can vary between brown, gold or grey formed from the molten lava after solidification. The production of basalt fibre consists of melt preparation, extrusion, fibre formation, application of lubricates and finally winding. The functions of the fibres are to carry the load and provide stiffness, strength, thermal stability. Basalt fibre has a higher compressive strength and higher shears strength. It is used as a load bearing profiles, high pressure vessels, bridges and highways bullet proof vests and retrofitting and rehabilitation of structures.

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 (CH_2=CH-CH=CH_2) and 25 percent styrene (CH_2=CHC_6H_5).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, Dr. Fixit Pidicrete URP SBR Latex Polymer 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 CONPLAST – SP 430 G8.

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 and beams were of steel having an internal dimension of 150 mm x 150 mm x 150 mm for cube and 100 mm x 100 mm x 500 mm for beam.The cement, coarse and fine aggregate and superplasticizer were mixed thoroughly with the help of mechanical mixer. Then basalt fibre is dispersed to the above mixture while mixer is working. SBR latex is mixed in water and is put into the mixture.The concrete was poured into the moulds in three layers by tamping with a tamping rod. The SBR latex is varied in a fraction of 0%, 2%, 4%, 6%, 8%, 10% and 12%. The percentage at which maximum strength is obtained was taken to vary basalt fibre in a percentage of 0.25%, 0.5%, 0.75%, 1% and 1.25%. 3 cubes and 3 beams specimen are made for each set.

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.

III. RESULTS

TABLE FOR COMPRESSIVE STRENGTH

Table 4Variation of SBR Latex

Latex Percentage	Average Compressive Strength at 28 Days (N/mm²)
0%	34.59
2%	35.64
4%	36.87
6%	40.86
8%	41.82
10%	40.74
12%	38.58

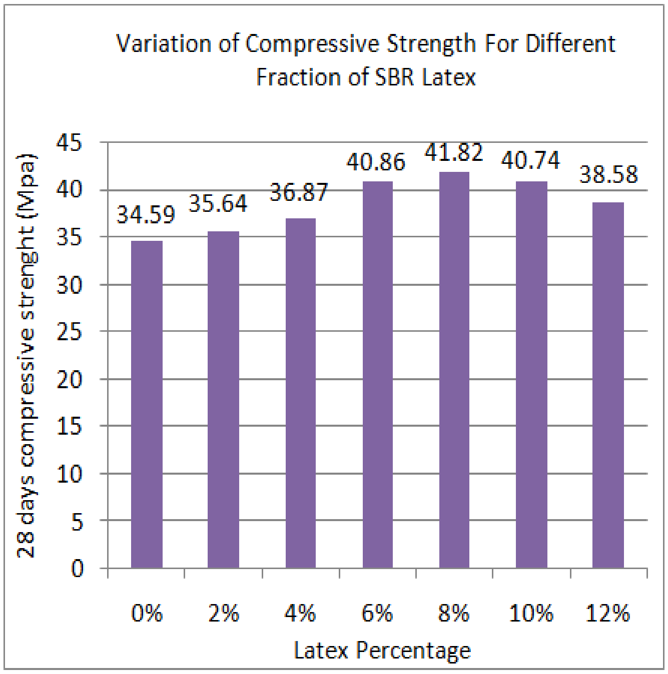


Table 5 Variation of SBR Latex + Basalt Fibre

SBR Latex% + Basalt Fibre%	Average Compressive Strength at 28 Days (N/mm²)
8% SBR Latex + 0.25% Basalt Fibre	38.23
8% SBR Latex + 0.50% Basalt Fibre	42.57
8% SBR Latex + 0.75% Basalt Fibre	39.06
8% SBR Latex + 1.00% Basalt Fibre	36.81
8% SBR Latex + 1.25% Basalt Fibre	34.20

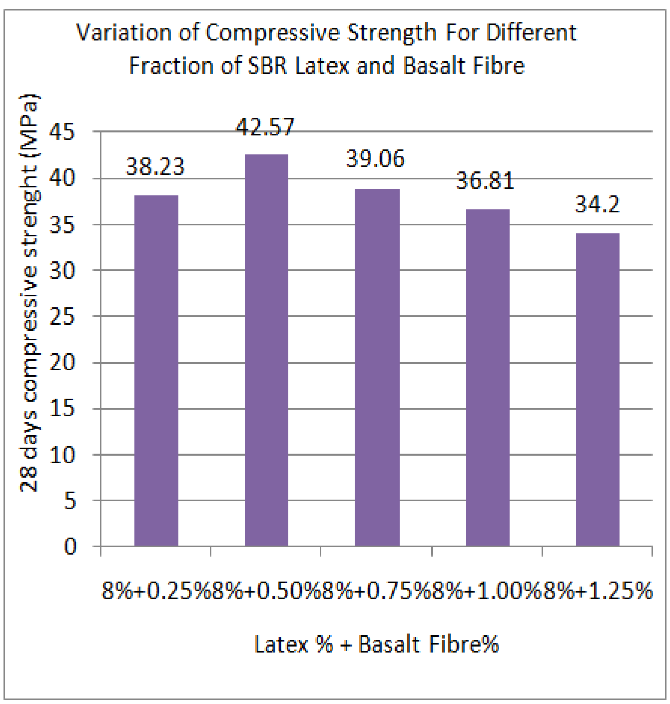
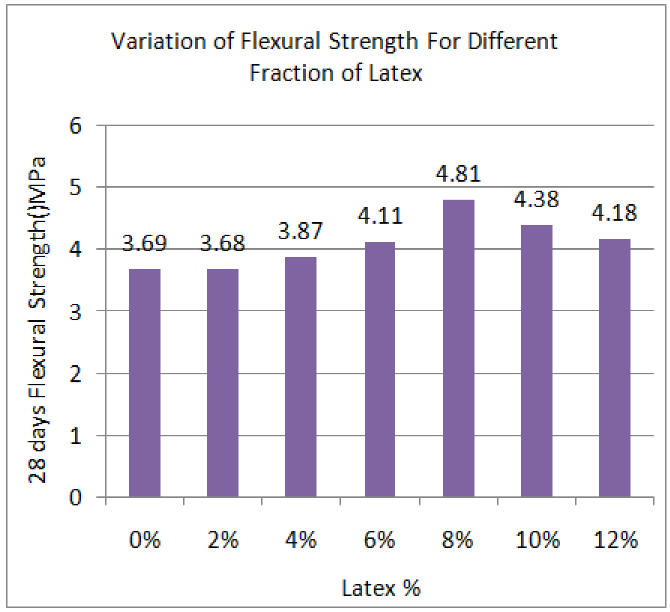


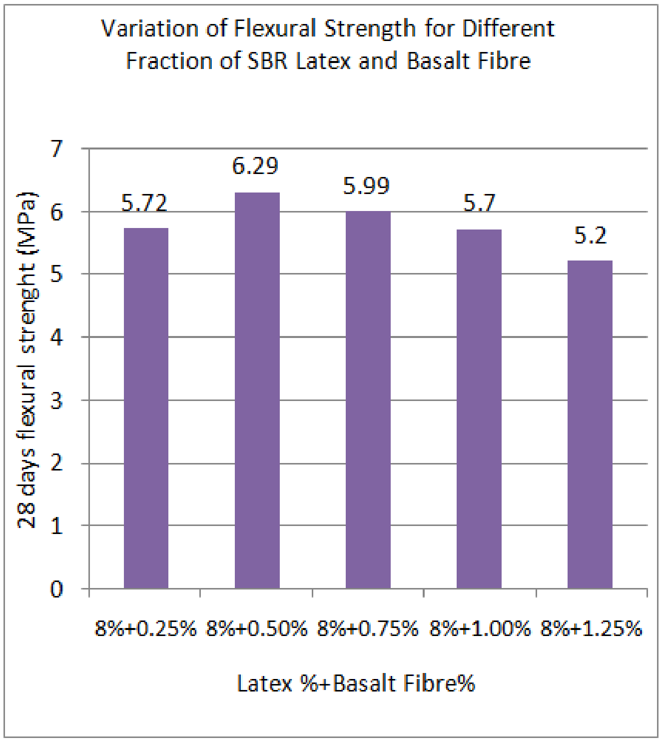
TABLE FOR FLEXURAL STRENGTH

Table 6 Variation of SBR Latex

Latex Percentage	Average Flexural Strength at 28 Days (N/mm²)
0%	3.69
2%	3.68
4%	3.87
6%	4.11
8%	4.81
10%	4.38
12%	4.18



SBR Latex% + Basalt Fibre%	Average Flexural Strength at 28 Days (N/mm²)
8% SBR Latex + 0.25% Basalt Fibre	5.72
8% SBR Latex + 0.50% Basalt Fibre	6.29
8% SBR Latex + 0.75% Basalt Fibre	5.99
8% SBR Latex + 1.00% Basalt Fibre	5.70
8% SBR Latex + 1.25% Basalt Fibre	5.20



IV. CONCLUSIONS

In the present study, the mechanical properties of three types of concrete namely plain concrete, latex modified concrete and latex modified basalt 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 and flexural strength has their maximum values for 8% SBR latex dosage among all latex variations. The compressive strength is increased by 20.90% and flexural strength by 30.35% when compared to their nominal strength. For any further increase in latex content the values of strengths decrease gradually.

2. When basalt fibre is added along with 8% SBR latex dosage, maximum strengths are obtained at 0.5% of fibre. The compressive strength is increased by 23.10% and flexural strength by 70.46% when compared to their nominal strength.

3. The test results show that by using 0.5% basalt fibre along with 8% SBR latex, the compressive strength increased by 1.79% and flexural strength by 30.77% when compared to strength values for 8% latex alone.
4. Compressive and Flexural strength decrease for any further increase in the quantity of latex above 8% 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.

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