SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 11 | November 2024 - Peer Reviewed Journal

STUDY AND ANALYSIS OF SBR-STEEL FIBER REINFORCED CONCRETE WITH LATEX MODIFICATIONS

[1]Santosh Kumar Singh, [2]Dr. Jyoti Yadav
[1]M.Tech Scholar, [2]Assistant Professor, Department of Civil Engineering, Sarvepalli Radhakrishnan University, Bhopal, M.P, India

ABSTRACT
The current study aims to investigate the behavior of steel fiber reinforced concrete (steel fibers combined with M25 Grade concrete), SBR-latex modified steel fiber reinforced concrete (SBR-latex and steel fibers combined with M25 Grade concrete), convectional concrete (M25 Grade concrete), and SBR-latex modified convectional concrete (SBR-latex combined with M25 Grade concrete). The purpose of the experimental investigation was to determine the compressive, split tensile, and flexural strength properties of the aforementioned matrix.According to the aforementioned research, the concrete that had fiber and latex added performed much better in terms of having a greater ultimate load and first fracture load as well as less deflection. This is because the concrete matrix's latex and fiber infill have made it more compact.
KEYWORDS: *SBR- Latex reinforced concrete, compressive strenth, flexural strength, split tensile strength,silica fumes,steel fibers.*

1. INTRODUCTION

When evaluating technological advancements across time, it is clear that material development plays an important influence. Considerable efforts are still being undertaken around the world to produce novel construction materials. Concrete technology is entering a new phase in the construction business by incorporating polymers and fibers, as well as Super plasticizer, into concrete. Over the last decade, there has been a growing interest in novel materials. This is comprehensible, as it is gradually but more acknowledged that economic growth in construction is dependent on the intelligent use of resources and the continuous improvement of available materials rather than radical refinements of structural analysis. Concrete is perhaps the most frequently used material in the world due to its strength, structural stability, longevity, economic considerations, and low level maintenance, and Portland cement, the most essential element of concrete, is a flexible and reasonably inexpensive substance. With the widespread usage of cement in a variety of situations, technologists catered to the needs of certain construction applications. Pozzolanas, retarders, accelerators, and other admixtures are now being employed. Compressive strength is commonly used to describe concrete. It has been discovered that microstructure is extremely crucial for macro performance. The adaptability of concrete as a building material propelled research into upgrading an age-old material, as did the demand for taller reinforced concrete structures, which fueled the pursuit of higher concrete strength. This was made possible by the advent of superplasticizers and the use of admixtures, the most notable of which is the ability to boost the compressive strength of concrete. Furthermore, high performance concrete structures, unlike steel structures, tend to fracture or break in a very brittle fashion due to concrete's limited ductility or deformation capacity. In such constructions, brittle failure due to inelastic deformation can be avoided only if the concrete is engineered to act ductilely, allowing the part to absorb and release a substantial amount of energy.

As a result, numerous studies have been conducted to investigate the mechanical and strength properties of fiber reinforced concrete. The basic function of fibers in hardened concrete is to alter the cracking mechanisms. By altering the cracking mechanism, macro cracking is transformed into micro cracking. The cracks are smaller in width, lowering permeability and increasing ultimate cracking strain. The fibers can transport a load across a crack. A significant benefit of employing fiber reinforced concrete (FRC) in addition to reducing permeability and boosting fatigue strength is that fiber insertion improves toughness and load bearing ability after the first crack in flexure behavior.

- **Latex Modified Steel Reinforced Concrete**

In recent years latex modified mortars and concrete have been used widely as construction materials because of their improved properties of high strength, extensibility, adhesion, water proofness and durability. In general latex modified concrete show noticeable increase in tensile strength, adhesion, bond strength, impermeability and durability, etc. Latex modified steel fiber reinforced concrete is made of hydraulic cement, containing fine and coarse aggregate, discontinuous discrete fibers and polymer

SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 11 | November 2024 - Peer Reviewed Journal

(SBR-latex). When fibers and polymer are added to conventional concrete they improve mechanical properties of conventional concrete significantly. Recent test on polymer modified steel fiber concrete indicate that they are more durable.

2. MATERIAL AND METHOD

A series of specimens are chosen for the investigation and all are having a unique nominal sectional dimensions for cubes 150 X 150 mm, cylinders 150 mm dia. and 300mm height and prisms 100 X 100 X 500mm respectively. Plain cement concrete (M25 grade of concrete). Plain cement concrete with Styrene butadiene Rubber latex (M25 + SBR-latex). Plain cement concrete with Steel fibers (M25 + Steel fibers). Plain cement concrete with steel fibers and Styrene Butadiene Rubber Latex (M25 + steel fibers + SBR-latex). The details of experimental studies including characterization are presented below.

- **Materials used**

Ordinary Portland Cement (OPC) was used for all the test specimens.Silica is added to reduce the dosage of chemical admixtures needed to get required slump 12 nominal maximum aggregate is used as coarse aggregate and fine aggregate is the natural sand free from impurities. The properties of steel fibers are shown in table 1.

Table 1: Properties of Steel Fibers

Type	Crimped round
Length	36mm
Diameter	0.45mm
Aspect ratio	80

The properties of the SBR Latex are given in the table 2.

Table 2: properties of the SBR Latex

Polymer Type	Styrene Butadiene 68 ± 3% Styrene 32 ± 3% Butadiene
Average Polymer Particle Size	1500 to 2500 Angstroms
Emulsion Stabilizers	Anionic and non-ionic surfactants
Percent Solids	46.20
Weight per liter, Kg at 25°C	1.005 to 1.039
Ph	9.5 to 10.50
Color	White

- **Mix Proportioning**

A concrete mix grade of M25 is aimed, the designed mix proportion is obtained by IS method of mix design. Then to the target strength of designed mix obtained, the steel fiber and latex are added. Various trial mixes were carried out to obtain optimum dosage of super plasticizer, silica fume and steel fiber with regards to get required workability. A detailed study on mix proportion has been carried. For SBR+M25 the mix ratio adopted is 1: 1.21: 2.07 with w/b ratio of 0.44., and 10% SBR-latex by weight of binder was added to the mix. For SF+M25, the suitable mix ratio adopted is 1: 1.21: 2.07 with w/b ratio of 0.44, and steel fiber content was 0.75% by volume is incorporated. For SBR+SF+M25, the suitable mix ratio adopted is 1: 1.21: 2.07 with w/b ratio of 0.44., 15% SBR-latex by weight of binder was added to the mix and steel fiber content was 0.75% by volume is incorporated and in all above mixes 7% of silica fume was added as a partial replacement for cement to mix super plasticizer (Glenium-51) was added in the ratio of 1% of binder.

3. TEST ANALYSIS AND RESULT

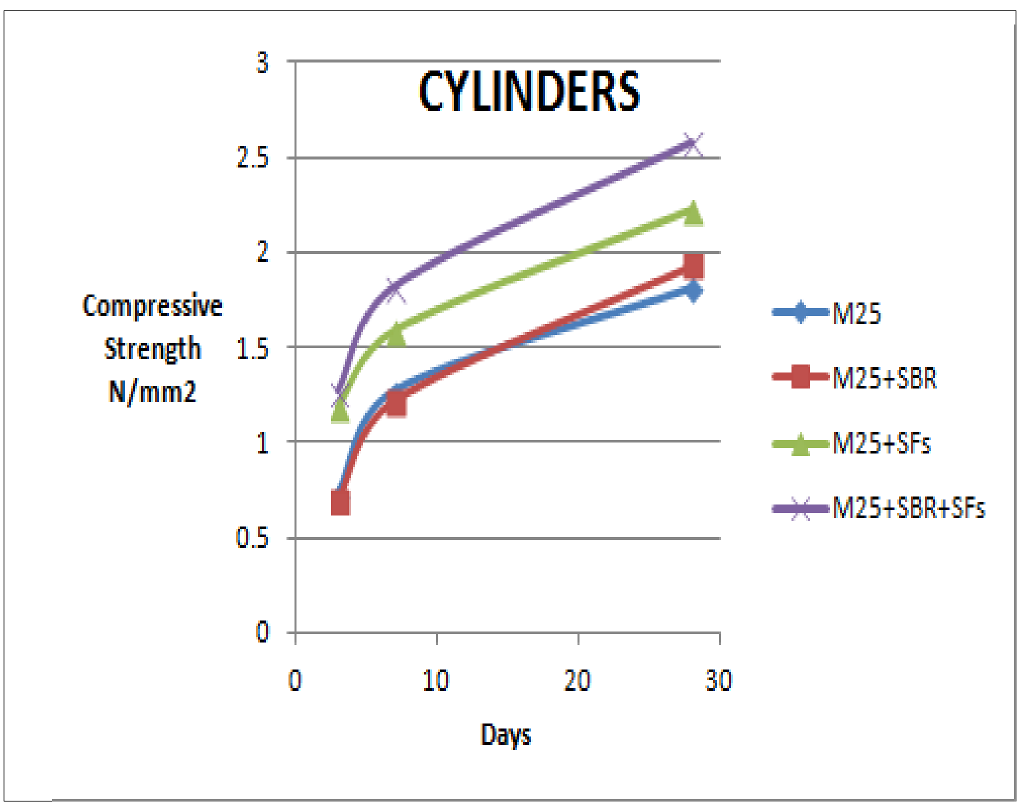
The average test readings of the soecimens for 3, 7 and 28 days are shown in table 3.

SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 11 | November 2024 - Peer Reviewed Journal

Table 3: Test Results of the specimens

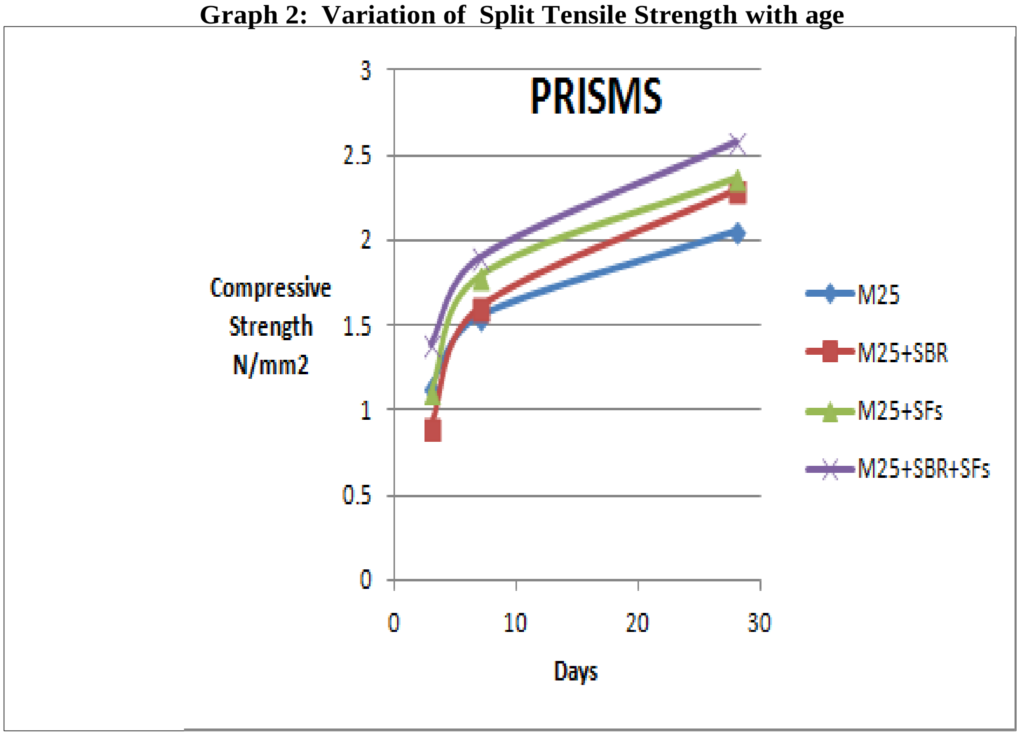
Properties	Age	M25	M25+SBR	M25+SFs	M25+SBR+SFs
Compressive strength (N/mm^2)	3 days	13.13	10	14.33	17.3
	7 days	20.66	13.16	25.1	21.9
	28 days	33	26.16	35	32.5
Split tensile strength (N/mm^2)	3 days	0.73	0.69	1.19	1.27
	7 days	1.27	1.22	1.59	1.82
	28 days	1.81	1.93	2.22	2.58
Flexural strength (N/mm^2)	3 days	1.14	0.9	1.11	1.39
	7 days	1.55	1.6	1.79	1.9
	28 days	2.05	2.29	2.36	2.58

Graph 1: Variation of compressive strength with age

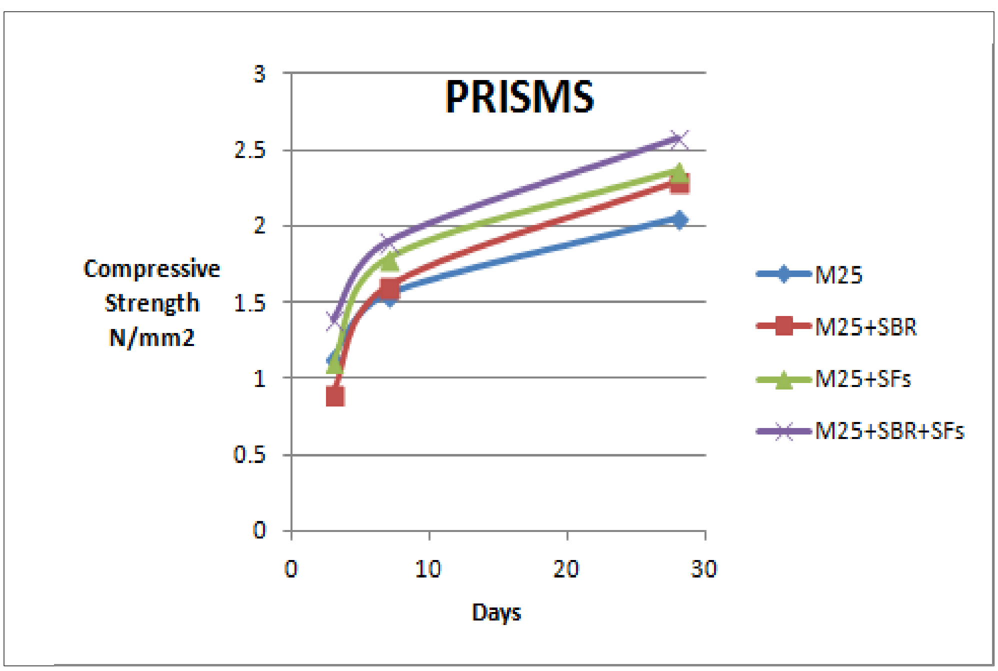


SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 11 | November 2024 - Peer Reviewed Journal

Graph 2: Variation of Split Tensile Strength with age



Graph 3: Variation of Flexural Strength with age



4. CONCLUSIONS

1. Several variables can influence the physical and mechanical behavior of concrete. These include the concrete mix's composition, aggregate type and shape, admixtures, and the addition of fibers and other additional reinforcement.
2. At 28 days, the compressive strength of four mixtures (M25, SBR+M25, SF+M25, and SBR+SF+M25) were 33Mpa, 26.16Mpa, 35Mpa, and 32Mpa.
3. In the case of SBR-latex modified concrete, compressive strength decreases. This is due to the decreased density of latex

compared to the matrix density. Furthermore, the combination of SBR-latex and steel fiber demonstrated an improvement in compressive strength.

4. Experimental results show that the SBR+SF+M25 has a significant increase in flexural strength when compared to other matrix types.
5. This is due to the compactness, which is accomplished through the filling of voids in the matrix with latex and fibers in the concrete matrix.

REFERENCES

1. *Nagaraj T. S., Sundara Raja Iyengar K. T., and Kameswara Rao B. (L), "Super- Plasticized Natural Rubber Latex Modified Concretes," Cement and Concrete Research,Vol.18, 1988, pp.138- 144.*
2. *Banthia, N. and Trottier, "Concrete Reinforced with Deformed Steel fibers, (i)Bond-slip mechanisms" ACI Materials Journal, Sept-Oct 1994, Vol. 91,No. 5, pp 435-446.*
3. *Barluenga G., and Hernandez-Olivares F(L)., "SBR Latex Modified Mortar Rheology and Mechanical Behaviors," Cement and Concrete Research,Vol.34, 2004, pp. 527-535*
4. *Bindiganavile, V., and Banthia, N., "Polymer and Steel Fiber-Reinforced Cementitious Composites under Impact Loading-Part-1:- Bond-Slip Response," ACI Materials Journal, Vol. 98, No.1, Jan-Feb., 2001, pp.10-16.*
5. *Collepardi, M., Moriconi, G., Pauri, M., Biagini, S., and Alvera, "Super plasticized Silica Fume High-Strength Concretes" Admixtures for Concrete: Improvement of Properties, Proceedings of the International Symposium held by RILEM, May 14-17 1990, Barcelona, Spain; Ed. by E Vazquez; Chapman and Hall, London, 1990, pp 175-182.*
6. *Ezeldin, A. Samer; Shiah, "Analytical Immediate and Long-term Deflections of Fiber Reinforced Concrete Beams", Journal of Structural Engineering,Vol. 121, No. 4,Apr 1995. pp727-736.*
7. *Indrajit Ray, A P Gupta and M Biswas, "Effect f Latex and Superplasticizer on Portland Cement Mortar in the Fresh State," Cement & Concrete Composites, Vol. 16, 1994, pp. 309-316*
8. *Ko M Y, Kim S W and KIm K, "Experimental Study on the Plastic Capacity of Reinforced High Strength Concrete Beams", Materials and Structures, Vol. 34,June 2001, pp. 302-311.*
9. *Mak, S. L and Sanjayan. G. "Mix Proportions For Very High Strength Concretes" ,Second National Structural Engineering Conference, Oct 3- 1990,Adelaide, Australia; National Conference Publication - Institution of Engineers, Barton, Australia, No. 90, Pt. 10, pp 127-130.*
10. *Parviz Soroushian and Ziad Bayasi, "Fiber Type Effects on the Performance of the Steel Fiber Reinforced Concrete," ACI Material Journal, Vol. 88,No.2,Mar- Apr.,1991, pp.1.79-1*