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"COMPRESSIVE STRENGTH OF POLYMER MODIFIED STEEL FIBER REINFORCED CONCRETE"

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ABSTRACT
Concrete is a key material in the construction industry, but it comes with certain limitations. Addressing these limitations requires the development of durable and sustainable construction materials. This has led to the evolution of concrete composites, which combine various compounds to expand their applications in the field of cement-based construction. Advances in understanding material behavior, particularly in admixtures and curing processes, have paved the way for high-performance mineral and modified mineral concretes, mortars, and grouts. Significant research has also focused on enhancing the properties of traditional concrete through the integration of fibers and polymers. Both fiber-reinforced concrete and polymer-modified concrete have significantly enhanced performance, with each domain deriving advantages from the innovations presented by the other. The interplay between traditional construction materials and polymers has facilitated notable progress in the realm of construction materials. This research examines the compressive strength of polymer-modified steel fiber-reinforced concrete, wherein the volume fraction of steel fibers is varied from 0% to 5% in increments of 1% relative to the weight of cement. Furthermore, a 15% SBR latex polymer, expressed as a percentage of the weight of cement, was integrated into the mixture. Compressive strength evaluations were performed on cubic specimens measuring 150 × 150 × 150 mm after a curing period of 28 days.

Keywords
Compressive strength, Steel Fiber Reinforced Concrete, Polymer Modified Steel Fiber Reinforced Concrete.

1. INTRODUCTION

GENERAL

Concrete has been extensively employed as a construction material for over 170 years, recognized for its adaptability and structural integrity. Nonetheless, notwithstanding its widespread acceptance, it presents significant disadvantages, including protracted hardening, inferior tensile strength, considerable drying shrinkage, and inadequate chemical resistance. To mitigate these constraints, initiatives have been undertaken to augment conventional cement concrete through the integration of polymeric additives. These additives encompass thermoplastics, thermosetting resins such as epoxy, elastomers or rubbers, and natural polymers like cellulose, lignin, and proteins. The utilization of polymers in cement composites is increasingly preferred owing to their enhanced performance, multifunctionality, and sustainability when juxtaposed with traditional concrete.

Polymer-modified concrete exhibits a cohesive co-matrix, wherein the organic polymer matrix and the cement gel matrix are meticulously homogenized. A diverse array of polymer additives, including latex, re-dispersible polymer powders, water-soluble powders, liquid resins, and monomers, are employed to modify the concrete matrix. For optimal performance, it is imperative to ascertain that both cement hydration and polymer phase development transpire effectively. This engenders a monolithic matrix with an interpenetrating network structure, which interlocks aggregates within the co-matrix phase, thereby significantly augmenting the quality of polymer-modified concrete.

Concrete is esteemed as a premier construction material due to its robustness, economic viability, structural dependability, and versatility. The evolution of materials technology has engendered safer, more functional, and cost-efficient solutions to fulfill societal demands. The integration of fibers and polymers into concrete is anticipated to proliferate, particularly for restoration and rehabilitation endeavors, encompassing bridges, industrial floors, airport pavements, overlays, high-rise edifices, television towers, parking structures, offshore constructions, and historical monuments.

Innovations within the construction sector persist in concentrating on the development of novel and enhanced materials to satisfy the requirements of mega-structures. Such undertakings necessitate materials with superior properties, especially toughness, which is attained through the incorporation of additives, polymer admixtures, and fibers. Toughness, characterized as the energy absorption capability of a composite, constitutes a pivotal property of fiber-reinforced concrete. It is quantified as the ratio of energy necessitated to deflect a beam to a predetermined deflection concerning the initial crack energy.

Fiber reinforcement assumes an essential role in augmenting the mechanical characteristics of cementitious materials. It enhances toughness, ductility, flexural strength, and the adhesion between steel and concrete while concurrently diminishing shrinkage cracking and permeability. Furthermore, fiber reinforcement bolsters fatigue and impact resistance, rendering it particularly advantageous for specialized applications such as earthquake-resistant structures, impact-resistant designs, and tunnel linings. Ultimately, fiber-reinforced concrete offers a versatile and resilient solution for advanced construction requirements.

2. LITERATURE REVIEW

The characteristics of concrete are being improved through extensive research and experimentation. Traditional concrete's composition has been altered to enhance its properties. The idea of adding fibers to a brittle matrix originated in ancient Egypt, when mud bricks and buildings were reinforced with materials like animal hair and straw (Balaguru et al., 1992). An overview of the development and evolution of fiber-reinforced concrete was given by Ronald F. Zollo (1997), who traced the formal investigation of this material back to the early 1960s. Steel fibers have been the subject of several investigations, but less is known about other fibers including nylon, plastic, rubber, and natural fibers.

The use of polymers to repair existing concrete structures was examined by R. Radhakrishnan (2012), who emphasized the significance of choosing the right materials and application techniques to guarantee successful restorations. The impact of adding 20% SBR by weight of cement and SBR latex to a cementitious mortar mix (1:3 ratio) was investigated in this study. SBR-modified mortar demonstrated higher compressive and tensile strength, water resistance, and performance under thermal cycling as compared to unmodified specimens. According to the study's findings, SBR is an ASTM-compliant modifier and bonding agent that works especially well for structures in tropical environments.

Experimental research on high-performance fiber-reinforced concrete with fiber volume fractions as high as 3.75% was carried out by Balaguru and Najm. Their findings demonstrated a notable improvement in material toughness—roughly 100%—when compared to traditional steel fiber-reinforced concrete. When compared to straight fibers and polypropylene microfibers, hooked steel fibers showed the highest level of toughness. Concrete with fiber reinforcement has improved mechanical qualities, energy absorption capacity, and post-cracking strength. A number of variables, including fiber geometry, type, size, volume, and distribution, affect how well fiber reinforcement works.

Fiber reinforcement dramatically improves concrete's post-cracking flexural toughness, according to Banthia and Bindiganavile. After analyzing the mechanical characteristics of concrete with different fibers and fly ash, Topeu and Canbaz came to the conclusion that while fly ash reduces workability and strength losses brought on by fibers, fibers enhance performance. Mirsayah and Banthiya used fibers with distinct shapes to examine the shear behavior of fiber-reinforced concrete. Their results showed notable increases in toughness and shear strength, especially at larger fiber doses. Similar findings were made by Nehdi and Landanchuk, who discovered that optimal fiber combinations improve flexural strength and toughness, facilitating improved energy absorption during bending and better stress transmission over fractured portions.

Altun et al. observed that steel fibers reduce crack formation, size, and propagation in beams subjected to bending moments, leading to improved toughness. Taylor et al. studied toughness characterization in fiber-reinforced concrete modified with SBR latex polymer, reporting enhanced toughness under various loading conditions and across different fiber volume fractions.

3. MATERIALS AND METHODOLOGY

INTRODUCTION

The preparation of concrete involves the use of several materials. In this context, we will discuss the various components utilized in the concrete preparation process for this experimental investigation, along with their respective properties. One of the key materials used in this study is Rice Husk.

MATERIALS USED

Aggregates

Coarse aggregate

Fine aggregate

Cement

SBR latex (Polymer)

Hooked End Steel Fibre

Water

Aggregates

Aggregates play a crucial role in concrete as they provide structure, minimize shrinkage, and contribute to cost efficiency. They are sourced from sedimentary, igneous, and metamorphic rocks and make up 70-80% of the concrete's total volume. Thus, selecting high-quality aggregates is essential for any concrete mix. Aggregates should be clean, durable, strong, and properly graded in size to maximize the efficiency of the cement paste. While aggregates were once thought to be chemically inert, it is now understood that some are chemically reactive, and certain types form a chemical bond with the cement paste at their interface. Both coarse and fine aggregates of varying sizes are utilized to achieve optimal bulk density.

3.2.1(A) Coarse Aggregate

These materials consist of crushed, uncrushed, or partially crushed gravel or stone, with the majority retained on a 4.75mm sieve. They must be robust, durable, dense, and free from any adherent coatings. Additionally, they should not contain harmful quantities of disintegrated fragments, alkali, organic matter, or other detrimental substances. Flaky and elongated aggregates should be minimized to the greatest extent possible.

3.2.1(B) Fine Aggregate

Fine aggregate, commonly referred to as sand, consists of mineral grains formed through the natural breakdown of rocks. It differs from gravel based on particle size and is distinct from clay, which contains organic substances. Sand, often separated from organic matter by water currents, exhibits uniform grain size when naturally sorted. Typically, commercial sand is sourced from riverbeds or wind-formed sand dunes. Sand, with particle sizes greater than 0.07 mm, is used as fine aggregate in mortar and concrete and is primarily composed of silica. For construction purposes, sand used in mix designs is called standard sand (IS: 650). This type of sand should be quartz-based, light grey or whitish in color, and free from silt.

Cement

Cement, typically available in powdered form, becomes a paste when mixed with water and hardens into a solid mass once shaped. While various organic compounds are used to bond materials and are referred to as cements, these are categorized as adhesives. The term "cement" on its own generally refers to a construction material.

Ordinary Portland Cement (OPC) of 53 grade is a high-strength cement designed to meet the demand for stronger concrete. According to BIS standards, the compressive strength of 53 grade OPC must be at least 53 MPa after 28 days. This type of cement is especially beneficial for specialized applications such as prestressed concrete and certain precast concrete products that require consistently high strength. Additionally, 53 grade OPC is cost-effective as it produces high-grade concrete with lower cement content. In concrete mix designs for M-20 grade and above, the use of 53 grade OPC can reduce cement usage by 8-10%.

Advantages of OPC

- High quality leads to significant reductions in cement usage.
- Achieving exceptional compressive strength at early stages facilitates quicker de-shuttering.
- Enhanced resistance to sulphate attacks due to minimal C3A content.
- Ensures long-lasting and durable concrete.
- Enables cost-effective concrete mix designs.
- Low levels of alkalis, chlorides, magnesia, and free lime contribute to extended durability of concrete structures.

Status of OPC in India

Over 160 million tonnes of fly ash are generated annually by thermal power plants in India (A.K. Jain, 2011). Managing this byproduct has become a significant challenge for power generation facilities. Typically, large quantities of fly ash and bottom ash are either stored in ponds or used for landfilling to reduce disposal costs (Bumjoo Kim and Monica Prezzi, 2008). In 1985, research by CANMET confirmed the exceptional properties of high-volume fly ash (V.M. Malhotra, 1986). Various standards have capped the use of quality fly ash at 35% in the cement industry.

In India, the cement and concrete industries utilize approximately 40 million tonnes of fly ash annually. However, increasing demand for cement can be addressed by incorporating higher proportions (over 50%) of fly ash in concrete. This approach not only reduces costs but also minimizes greenhouse gas emissions, waste disposal issues, and health risks. As a result, the use of high-volume fly ash in concrete has emerged as a sustainable, durable, cost-effective, and resource-efficient alternative to ordinary Portland cement (OPC) for various applications (Crouch, L.K., et al., 2007).

Physical Characteristics of a OPC

Type of cement	OPC (IS 1489-1991)
Fineness (m^2/kg) Min	225
Soundness by Lechatelier (mm)	10
Soundness by Autoclave (mm)	0.8
Initial setting time(min)	30
Final setting time(min)	600
Compressive strength 28 Days	53Mpa

Chemical Characteristics of a OPC cement

Loss on ignition, percent, maximum	4
Insoluble Residue (%) Max	2
Magnesia (%)	6
C3A>5percent	2.5
C3A<5 percent	3

STYRENE BUTADIENE RUBBER (SBR Latex)

Styrene butadiene rubber (SBR) latex serves as a polymer in this context. It is available as a liquid that consists of 40% solid content and 60% water. The water present in the polymer is factored into the overall water content of the mixture, meaning the water-to-cement (w/c) ratio should be adjusted by subtracting the water already present in the polymer when adding additional water to the concrete mix. This polymer is a thermosetting material, not based on epoxy. Its properties are outlined as follows.

Fig1.1: SBR latex

Physical Properties of SBR latex

Property	Description
Polymer system	Polymer latex additive (Monobond)
Type	Latex
Appearance	Milky white
Setting characteristics	Slow
Viscosity at 270c (±2)	15 sec
Specific gravity at 270c (±2)	1.08
pH	10.4

Water

Water suitable for drinking is typically also appropriate for use in concrete production. It should be free from acids, oils, alkalis, plant matter, or any other organic contaminants. Water that is too soft can result in weaker concrete. In a concrete mix, water serves two main roles. First, it chemically reacts with the cement to form a paste that holds the inert aggregates in suspension until the paste sets and hardens. Second, it acts as a lubricant, facilitating the mixture of fine aggregates and cement.

Hooked End steel fibre

Steel fibres have demonstrated significant enhancements in the mechanical properties of fibre-reinforced concrete, particularly in tension. Among various types of steel fibres, hooked-end steel fibres stand out for their superior crack resistance and ability to bridge cracks at localized points, leading to improved pre- and post-cracking performance, increased ultimate load-bearing capacity, energy absorption, and ductility. When incorporated into self-compacting concrete, the distribution and alignment of fibres are more consistent, which minimizes variability in material properties and further boosts its mechanical performance.

Fig3.1: Hooked end Steel fibre

Description	Value
Length of fiber (*l*)	35
Thickness (diameter) of fiber (*d*)	0.5 mm
Aspect ratio (*l*/*d*)	70
Tensile strength	2000Mpa
Specific gravity	7.8
Modulus of elasticity	200Gpa

4. EXPERIMENTAL INVESTIGATION

TEST ON MATERIALS

Specific Gravity

Specific gravity is the ratio of the density of a substance to the density (mass of the same unit volume) of a reference substance. The reference substance is nearly
always water at its densest, (4°C).

Determination specific gravity of Materials by Pycnometer Theory

The Pycnometer method can be used for determination of the specific gravity of solid particles of both fine grained and coarse grained aggregates. The specific gravity is determined as followings:

Apparatus

Pycnometer

Weighing balance

Glass rod

Procedure

Take clean and dry Pycnometer and determine its mass (M1)

Fill 2/3 of Pycnometer with sample and determine the mass (M2)

Fill the Pycnometer with water completely and determine the mass (M3)

Empty the Pycnometer and fill with water and determine the mass (M4)

Formula

$$G = \frac{(M2-M1)}{(M2-M1)-(M3-M4)}$$

Where,

M1=Mass of empty Pycnometer

M2= Mass of the Pycnometer with dry sample

M3= Mass of the Pycnometer and sample and water M4 = Mass of Pycnometer filled with water only G= Specific gravity of solid

Specific Gravity of Fine Aggregates

S.N	Mass of empty Pycnometer (M1)gm	Mass of the Pycnometer with dry sample (M2)gm	Mass of the Pycnometer and sample and water (M3)gm	Mass of Pycnometer filled with water only (M4)gm	Specific Gravity (G)
1.	448	1128	1585	1160	2.67
2.	448	1118	1571	1155	2.64
3.	448	1124	1588	1168	2.65
Average(G)					2.65

Specific Gravity of Coarse Aggregates

S.N	Mass of empty Pycnometer (M1)gm	Mass of the Pycnometer with dry sample (M2)gm	Mass of the Pycnometer and sample and water (M3)gm	Mass of Pycnometer filled with water only (M4)gm	Specific Gravity (G)
1.	448	1146	1598	1160	2.69
2.	448	1148	1600	1161	2.68
3.	448	1153	1606	1163	2.7
Average(G)					2.69

MIX DESIGN

General

Concrete is widely used in the construction of various civil engineering structures due to its cost-effectiveness, ease of production, durability, and strength. However, the concrete mix design varies depending on the specific requirements of each structure. Not all concrete mixes are appropriate for every type of construction. The mix should be designed based on the desired strength and the conditions of the construction site. Concrete is made up of different materials, and their combination determines the final product.

The concept of concrete mix design was developed to optimize the selection of ingredients and their proportions, ensuring that maximum strength and durability are achieved in a cost-efficient manner. The proportioning of concrete materials depends on two key factors: the plastic state and the hardened state. The plastic state impacts the workability of the concrete, while the hardened state influences its compressive strength. The interaction between the aggregates and the cement paste is crucial in concrete. The paste provides workability through its lubricating effect, and its

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amount and consistency directly affect the overall properties of the concrete.
There are four factors that are to be considered for the concrete mix design
Water Cement Ratio
Cement –Aggregate Ratio
Gradation of the Aggregates

Consistency
In addition to the factors mentioned above, the economy of the design is also a crucial aspect of the mix design. Therefore, understanding the principles of an appropriate mix design is essential for concrete production.

Proportioning Methods
Several approaches can be used for mix design. Some common methods include the Surface Area Method, IRC 44 Method, Road Note No. 4, DOE Method, and IS 10262-2009 Method, among others. For this experiment, the IS 10262 method has been adopted. According to IS 456-2000, concrete mixes are classified into different grades based on the strength attained by cubes after 28 days, measured in N/mm². For instance, M20 refers to a mix grade where "M" denotes the mix and 20 represents the strength after 28 days.
Each grade mix has specific standard proportions. For M20, the ratio is 1:1.5:3, which corresponds to Cement: Fine Aggregate: Coarse Aggregate.

Mix Design Calculations for M20 Grade Concrete

The mix design for M20 grade concrete follows the guidelines outlined in IS 10262-1982. According to this standard, the following data is required to calculate the concrete mix design.
4o mini

1.	Characteristic Compressive Strength at 28 days	20 N/mm^2
2.	Cement	The cement used is OPC cement according to IS 1489-1991
3.	Coarse Aggregate	Corse Aggregate with maximum size 20mm.Specific Gravity 2.69
4.	Fine Aggregate	River sand was used as the fine aggregate conforming to grading zone II as per IS 383:1970. Specific gravity- 2.65
5.	SBR Latex	Specific gravity at 270c (±2) =1.08
6.	Hooked end steel fibre	Specific gravity=7.8
7.	Water Cement Ratio	0.50

Mix Design Procedure
Determination of target compressive strength.
Determination of water content as per size of the aggregate.
Selection of water cement ratio.
Calculation of cement content.
Determination of quantity of aggregates required.
Target Mean Strength

$f_m = f_{ck} + tS$ Where,
f_m = Target mean strength

f_{ck} = Characteristics strength at 28 days t = Tolerance factor
S = Standard deviation

$f_m = 20 + 1.65 \times 4 \quad (\because t=1.65, S=4)$

= 26.6Mpa

Selection of w/c Ratio

As the maximum size of aggregate to be used is 20mm, given by IS 10262-2009, water content is 186Kg per cubic meter. Corresponding to this value volume of sand in percentage to total volume of aggregate is 35.
Maximum size of aggregate = 20 mm Water content = 186 kg/m^3
% of fine =35, For M20 adjustment was made 33%

Cement Content

Cement = = 372 kg/m^3

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Fine and Coarse Aggregate

Assuming 2% air entrapped for zone II fine aggregate.

$$V = \left[W + \frac{C}{S_c} + \frac{1}{P} \times \frac{F_a}{S}\right] \times \frac{1}{1000}$$

$$0.98 = \left[186 + \frac{372}{3.15} + \frac{1}{0.33} \times \frac{F}{2.65}\right] \times \frac{1}{1000}$$

Fine Aggregate = 592 kg/m^3

$$V = \left[W + \frac{C}{S_c} + \frac{1}{1-P} \times \frac{C_a}{S_f}\right] \times \frac{1}{1000}$$

$$0.98 = \left[186 + \frac{372}{3.15} + \frac{1}{0.67} \times \frac{F}{2.69}\right] \times \frac{1}{1000}$$

Coarse aggregate = 1218.17 kg/m^3 Where,
V=absolute volume of fresh concrete W=mass of water per m^3 of concrete C=mass of cement per m^3 of concrete
S_c, S_f=specific gravity of cement and fine aggregate respectively and F_a=total mass of fine aggregate
P= Percentage of Fine

Hence for each m^3 of concrete comprises of, Cement=372 kg
Fine Aggregate= 592 Kg Coarse Aggregate= 1218.17 Kg Mix Proportion 1:1.59:3.27

CHAPTER – 5 RESULTS AND DISCUSSIONS

GENERAL

This chapter presents the results of compressive strength tests conducted on 63 concrete cubes, which were tested under varying curing periods of 7, 14, and 28 days. The cubes were prepared with a constant 15% latex and fiber content ranging from 1% to 5%. The compressive strength of these modified concrete samples was compared to that of normal concrete, which was cured under identical physical conditions. The fiber content varied between 1% and 5%, with the latex polymer content fixed at 15% by weight of the cement.

Test Results

To determine the strength of the concrete cubes, a compression test was performed on samples containing 15% SBR latex polymer (constant) and fibers in the range of 1% to 5% by weight of the cement. The following results were obtained from the compression tests conducted on hardened concrete at various curing intervals.

Compression Test

A compression test evaluates how materials behave under crushing loads. During this test, the specimen is subjected to compression, and its deformation is recorded at different loads. Compression tests are used to assess the behavior of a material when it is compressed, crushed, or flattened. Key parameters such as the elastic limit, yield strength, and Young's Modulus are measured. These parameters, typically associated with tensile testing, also have compressive counterparts. The compressive strength test is essential for the design process of concrete materials.

Strength of Concrete Normal concrete (NC) at various days:

Name of The Mix	Compressive Strength(N/mm^2) in days		
	7	14	28
NC	17.77	22.22	28.10

Table5.2.1 Strength of NC

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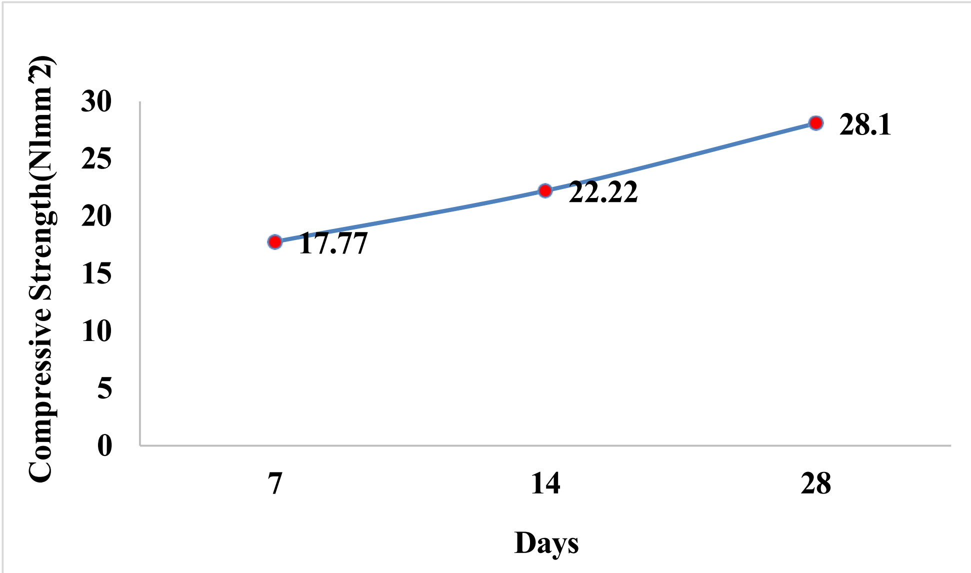
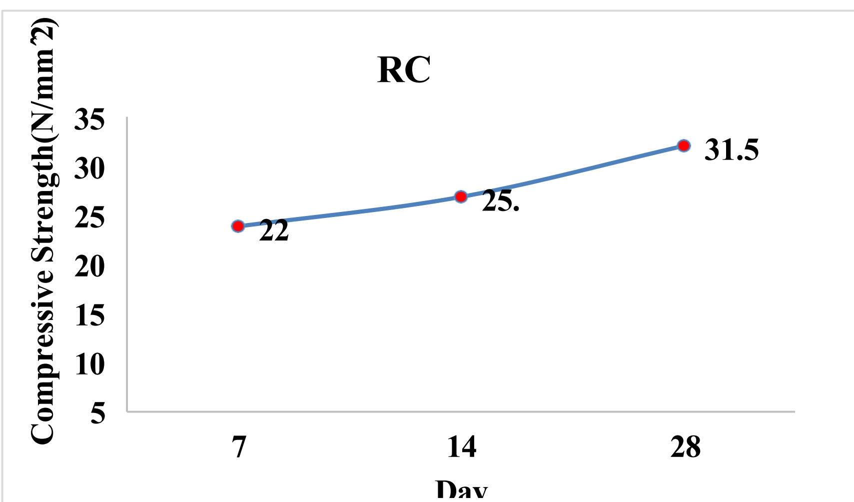


Graph: 5.2.1 NC Curve

Strength of concrete with 15%SBR latex and 0% fibre (RC0) at various days

Name of The Mix	Compressive Strength(N/mm^2) in days		
	7	14	28
RC0	22	25.55	31.55

Table: 5.2.2 Strength of RC0



Graph: 5.2.2 RC0 Curve

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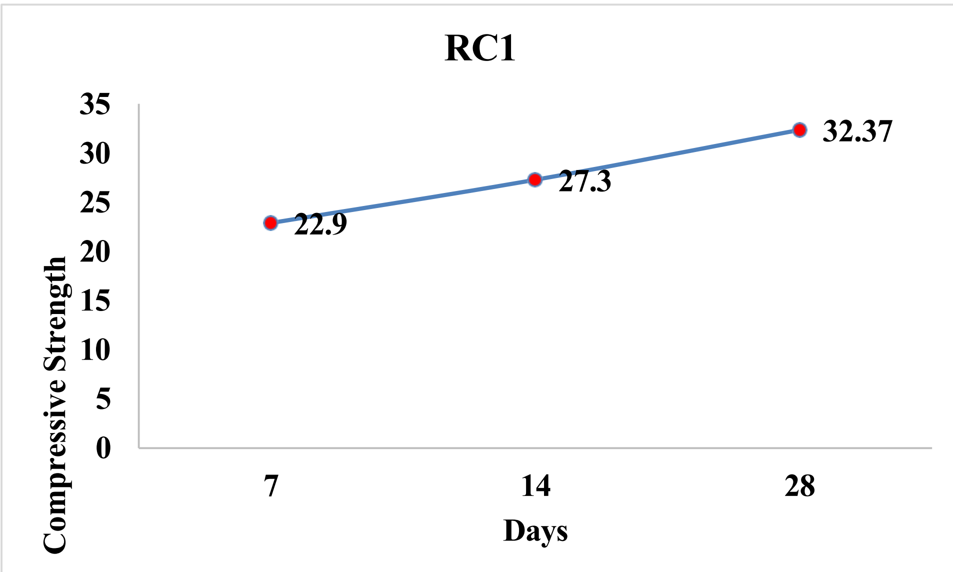
Strength of concrete with 15% SBR latex 1% fibre (RC1) at various days

Name of The Mix	Compressive Strength(N/mm^2) in days		
	7	14	28
RC1	22.9	27.30	32.37

Table: 5.2.2 Strength of RC1



Graph: 5.2.3 RC1 Curve

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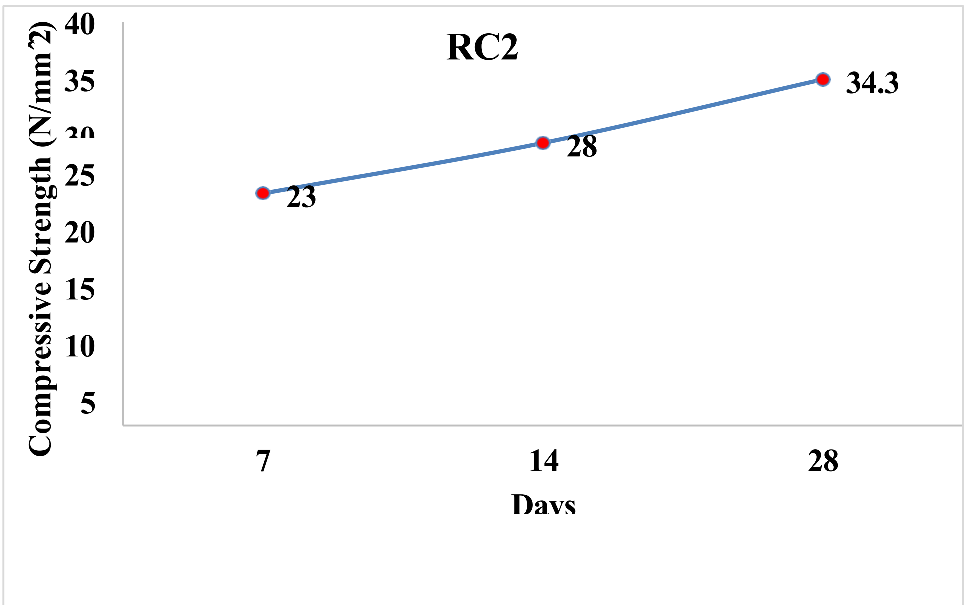
Strength of concrete with 15% SBR latex and 2% fibre (RC2) at various days

Name of Mix	Compressive Strength(N/mm^2) in days		
	7	14	28
RC2	23	28	34.3

Table: 5.2.4 Strength ofRC2



Graph: 5.2.4 RC2 Curve

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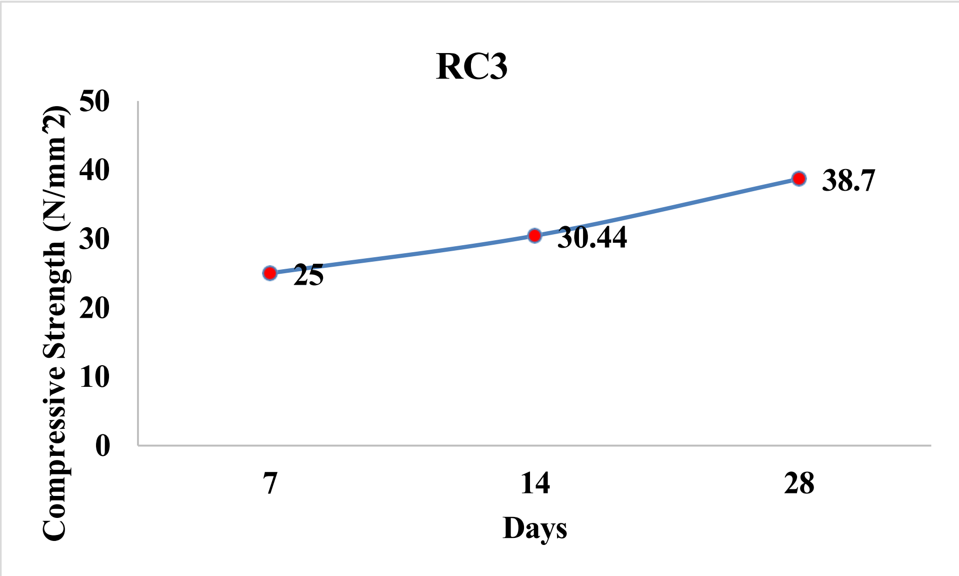
Strength of concrete with 15%SBR latex and 3% fibre (RC3) at various days

Name of Mix	Compressive Strength(N/mm^2) in days		
	7	14	28
RC3	25	30.44	38.7

Table: 5.2.4 Strength of RC3



Graph 5.2.5:RC3 Curve

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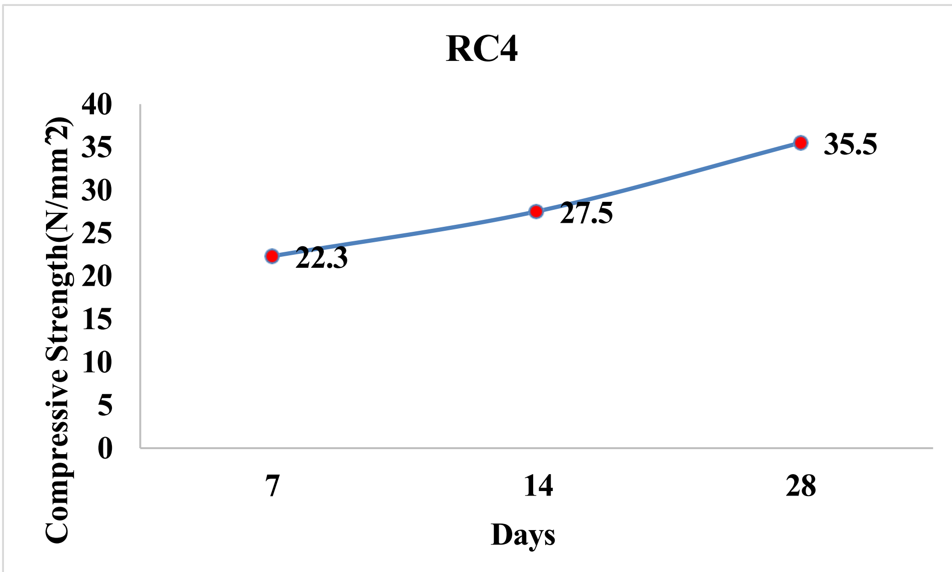
Strength of concrete with 15%SBR latex and 4% fibre (RC4) at various days

Name of Mix	Compressive Strength(N/mm^2) in days		
	7	14	28
RC4	22.3	27.5	35.5

Table: 5.2.5 Strength of RC4



Graph 5.2.6:RC4 Curve

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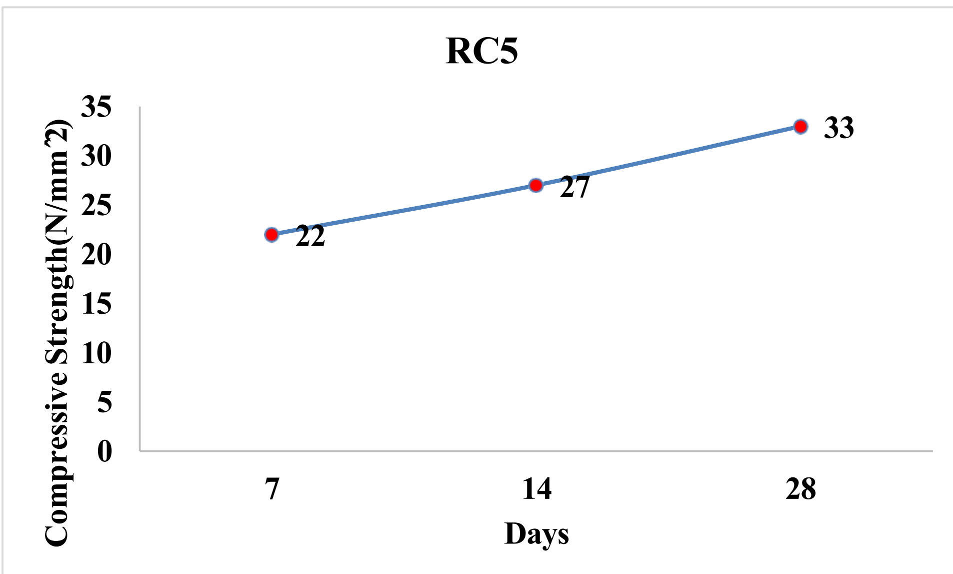
Strength of concrete with 15%SBR latex and 5% fibre (RC5) at various days

Name of Mix	Compressive Strength(N/mm^2) in days		
	7	14	28
RC5	22	27	33

Table: 5.2.6 Strength of RC5



Graph 5.2.7:RC6 Curve

COMPARISON OF COMPRESSIVE STRENGTH OF POLYMER MODIFIED STEEL FIBRE REINFORCED CONCRETE

: Comparison of 7 Days Strength of Normal and Polymer Modified Steel Reinforced Concrete

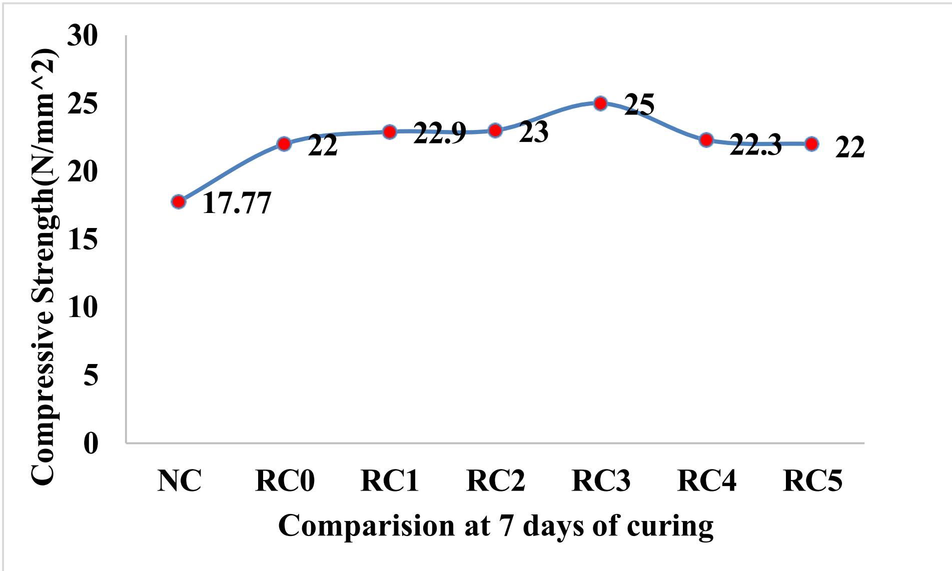


Fig5.3.1: Comparison at 7 days of curing

The graph shows the compressive strength of concrete at 7 days of curing period. From the above chart it can be seen that, the strength of Concrete is maximum at 3% i.e at RC3.As the percentage of the Fibres is increasing, the compressive strength is increasing up to 3% and again decreases.

: Comparison of 14 Days Strength of Normal and Polymer Modified Steel Reinforced Concrete

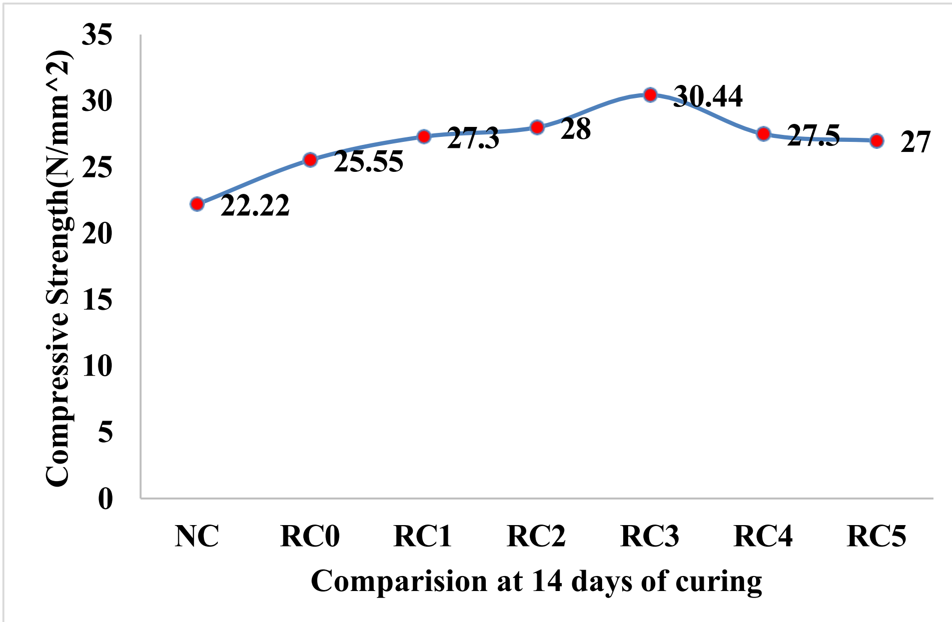


Fig5.3.2: Comparison at 14 days of curing

The graph above shows the compressive strength of normal and modified concrete after 14 days of curing period. The change in the compressive strength of the concrete is like that of the 7 days. The strength is tending to rise and attained maximum value of 30.44 N/mm^2 for the 3% polymer steel fibre concrete while that of the normal concrete is 22.22 N/mm^2.

: Comparison of 28 Days Strength of Normal and Polymer Modified Steel Reinforced Concrete Concrete

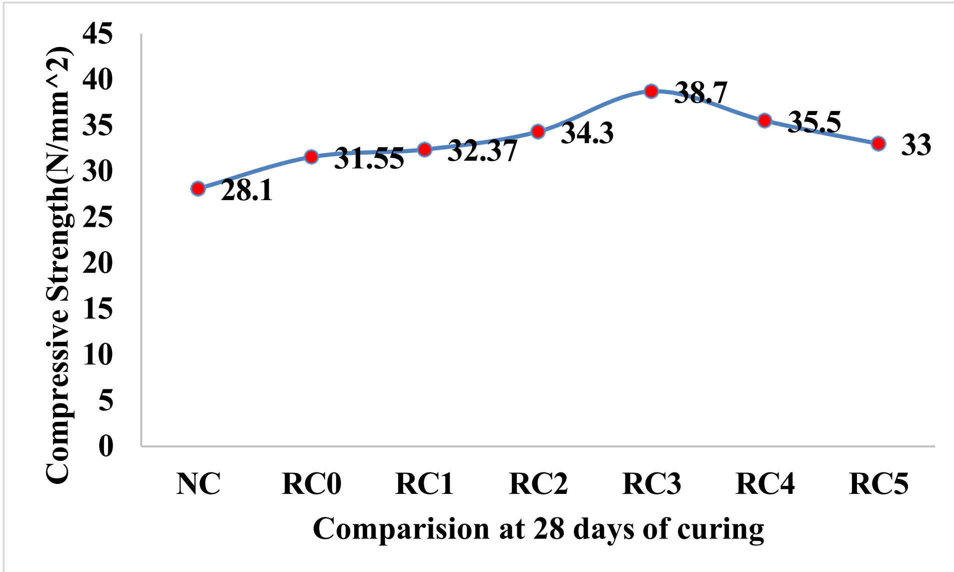


Fig5.3.3: Comparison at 28 days of curing

. The graph above shows the compressive strength of normal and modified concrete after 28 days of curing period. The change in the compressive strength of the concrete is like that of the 7 and 14 days. The strength is tending to rise and attained maximum value of 38.70 N/mm^2 for the 3% polymer steel fibre concrete while that of the normal concrete is 28.10 N/mm^2 .

CHPTER – 6 CONCLUSION

The incorporation of polymers in cement and aggregate creates a polymer-modified concrete that demonstrates significantly better performance compared to conventional concrete. The addition of polymers enhances workability, flexural strength, tensile strength, and bond strength. When polymers are added, they interact with the cement, filling the pores in the voids and creating a more uniform structure. Additionally, polymers form a protective layer on the cement and aggregate paste, reducing the concrete's permeability and minimizing water retention. This decrease in water retention reduces moisture content, which in turn helps reduce corrosion and protects the concrete from environmental damage. Polymers are also beneficial in strengthening cracked structures by improving the strength of cracks after applying polymer mortar to hardened concrete.

Both wet and dry curing are essential for achieving optimal results in the hydration and solidification of polymer-modified concrete. If the polymer is exposed to air for an extended period, it forms a skin or crust on the surface, which accelerates moisture evaporation and may cause surface cracking. Proper water curing is crucial, as it helps maintain concrete strength and prevents premature surface drying.

Observations have shown that after 28 days, the strength of concrete with 15% latex and 3% fiber by cement weight (RC3) reaches its peak at 38.70 N/mm². Strength increases up to 3%, but decreases beyond that. Overall, both fibers and polymers are highly effective in enhancing the strength of concrete composites.

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