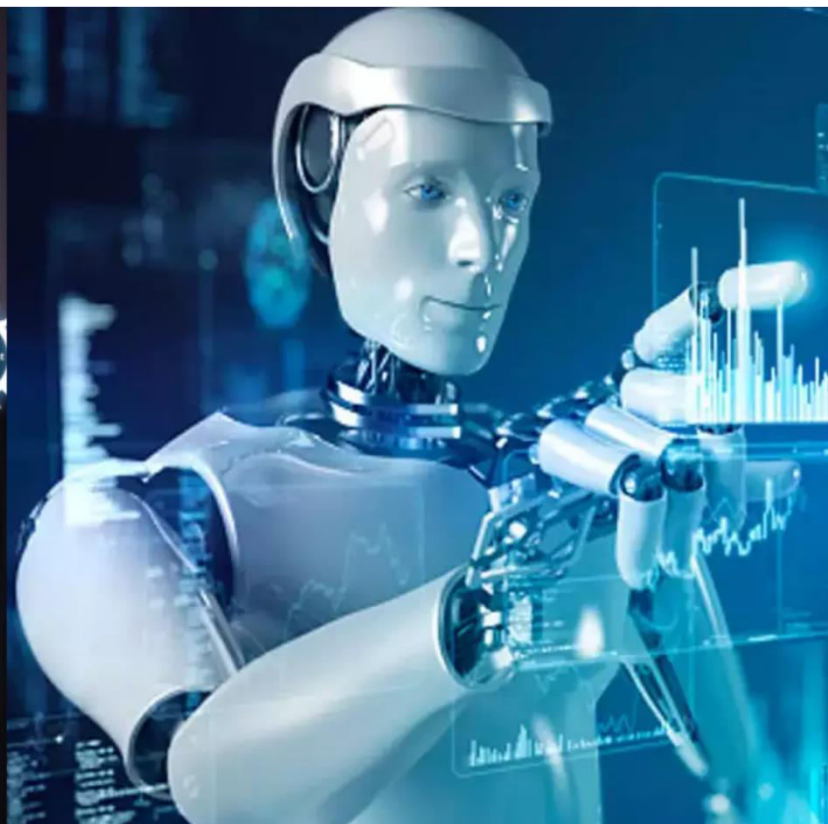




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Experimental Investigation on Stamp Concrete with Addition of Steel

Shivam Satish Shendge, N. P. Khatmode

P.G. Student, Department of Civil Engineering, TSSM's BSCOER, Narhe Pune, India

Associate Professor, Department of Civil Engineering, TSSM's BSCOER, Narhe Pune, India

ABSTRACT: Stamped concrete is a modern technique widely used for flooring in patios, car porches, driveways, and sidewalks. Despite its durability and visual appeal, it remains underutilized in the Indian market. This study investigates the enhancement of compressive strength in stamped concrete by incorporating 1.5%, 2%, 2.5%, and 3% steel fibers by weight of cement, aiming to make it suitable for heavy load applications. A questionnaire survey was conducted to compare market preferences among stamped concrete, tiles, and paver blocks. Additionally, a cost analysis between stamped concrete and tiles was carried out, with silicon stamps used in the concrete stamping process.

KEYWORDS: Stamped Concrete, Steel Fiber (SF), Compressive Strength, Flexural Strength

I. INTRODUCTION

1.1 Stamped Concrete

Stamped concrete is an innovative and aesthetically appealing flooring solution, commonly used in patios, car porches, driveways, and sidewalks. It not only enhances the visual appeal of surfaces but also provides strength and durability, making it a cost-effective alternative to expensive materials like granite and interlocking blocks. Often referred to as imprinted or textured concrete, stamped concrete can be finished to resemble materials such as slate, flagstone, brick, tile, or even wood, depending on the technique and skill applied. This makes it a popular choice for beautifying pool decks, courtyards, and residential entrances, especially for outdoor applications.



Figure 1.1- Sealing of Stamped Concrete

1.2 Applications

Stamped concrete is highly versatile and finds application in:

- Flooring with patterns mimicking tile, slate, fieldstone, or wood in interiors like kitchens, basements, and entrances.
- Vertical stamped overlays on walls and fireplaces using lightweight, sag-resistant mixes.
- Decorative concrete countertops and vanities with detailed imprints.
- Refurbishing existing concrete surfaces with stamp able overlays, replicating the same aesthetic as new stamped concrete installations.

II. LITERATURE SURVEY

[1]J.D. Chaitanya kumar et.al (2016) In this study, tests have done for the concrete with glass fibre of 0.5%, 1%, 2% and 3% of cement by adding as an admixture. Hence an attempt has been made in the present investigation to study the behaviour of glass fibre in concrete. The present trend in concrete technology is towards increasing the strength and durability of concrete to meet the demands of the modern construction. The main aim of the study is to study the effect of glass fibre in the concrete. Glass fibre has the high tensile strength and fire-resistant properties thus reducing the loss of damage during fire accidents. The addition of these fibres into concrete can dramatically increase the compressive strength, tensile strength and split tensile strength of the concrete.[2] D Florence More and Dr. S Senthil Selvan (2021) The purpose of this study is to compare the mechanical properties of Steel Fibre Reinforced Concrete with the Conventional Concrete. Steel fibres with four different percentages such as 0.5%, 1.0%, 1.5% and 2.0% were added to the concrete. Three different grades of concrete such as M40, M50, M60 were experimented in this study. Compressive strengths of cube specimens were calculated for these dosages with a curing period of 14 and 28 days. Optimization of the SFRC was done through the Compressive strength test results. It was observed that fibre dosage of 1.5% showed maximum values when compared with other percentages. With the optimized percentage of Steel Fibre, split tensile strength test was carried out. It was observed that the addition of steel fibres in concrete improved the compressive strength and split tensile strength of steel fibre reinforced concrete. At 28 days of curing with the addition of 1.5% of fibres, the compressive strengths of M40, M50 and M60 grades of concrete increased by 14.6%, 13.7% and 11.8% respectively compared with conventional concrete. Similarly, at 28 days of curing with the addition of 1.5% of fibres, the split tensile strengths of M40, M50 and M60 grades of concrete increased by 7.66%, 8.59% and 9.23% respectively compared with conventional concrete. [3] Estrella Quennie Mae et.al (2023) This study explores the effectiveness of steel fiber reinforced concrete (SFRC) as a structural element in a three-story low-cost housing building. SFRC incorporates small and hooked steel fibers into concrete, improving its mechanical properties, such as tensile strength, toughness, and ductility. This study aims to replace traditional reinforced concrete with SFRC in building columns and beams and assess its seismic performance using Finite Element Method (FEM) analysis conducted through SAP 2000 software. This study conducted experiments using concrete mix samples with different percentages of steel fibers (0%, 0.3%, 0.5%, and 0.7% by weight) and found that the 0.3% SFRC sample exhibited the highest compressive and flexural strength. Four models evaluated the cost effectiveness of SFRC compared to the control sample with regular concrete. The analysis revealed that Model (3), featuring 250 x 300 mm columns with SFRC, significantly decreased concrete volume and rebar quantity. It resulted in a 13.79% reduction in structural costs compared to the original plan. Overall, the study highlights the potential of SFRC to enhance the mechanical properties of concrete and reduce costs in seismic-resistant construction projects. By incorporating SFRC, engineers can improve buildings' structural stability and performance, particularly in earthquake prone regions.

III. METHODOLOGY

3.1 Materials

- Cement: Ordinary Portland Cement (OPC), 53 grade
- Fine Aggregate: Crushed sand
- Coarse Aggregate
- Steel Fibers
- Water: Potable

3.2 Procedure of Cube Casting for Compression Strength test

The cube casting procedure is a crucial step in determining the compressive strength of concrete. The process includes preparing the moulds, mixing concrete, placing and compacting the concrete, and curing the specimens before testing. The following is a detailed step-by-step procedure:

1. Preparation of Moulds

a) Cleaning the Moulds

- The 150mm × 150mm × 150mm steel cube moulds should be cleaned thoroughly to remove any dust, grease, or hardened concrete from previous use.

b) Applying Mould Release Oil

- A thin layer of mould release oil (such as mineral oil) is applied to the inner surfaces of the moulds. This helps in the easy removal of cubes after 24 hours.

c) Assembling the Moulds

- The moulds are properly assembled and tightened with bolts to prevent leakage of cement slurry.
- They are placed on a level and vibration-free surface to ensure uniform shape and dimensions.

2. Batching and Mixing of Concrete

a) Weighing Materials (Batching)

- The materials (cement, fine aggregate, coarse aggregate, and water) are weighed accurately as per the mix proportion for M20 grade concrete.

- If steel fibers are added, they are also weighed separately before mixing.

b) Mixing of Concrete

- For small-scale work (hand mixing):

- Cement and fine aggregate are mixed first to get a uniform color.
- Coarse aggregate is then added and mixed dry for 1-2 minutes.
- 50% of water is added gradually and mixed for another 2 minutes.
- The remaining water is added, and the mixture is mixed thoroughly for 3-5 minutes until uniform consistency is achieved.

- For large-scale work (machine mixing):

- The weighed materials are placed in a concrete mixer and mixed for about 2 minutes in a dry state.
- Water is added gradually, and mixing continues for 3-5 minutes to achieve a uniform mix.

3. Placing and Compacting Concrete in Moulds

a) Placing the Concrete

- The fresh concrete is poured into the cube moulds in three equal layers.

b) Compaction of Each Layer

- Hand Compaction:

- A tamping rod (16mm diameter, 600mm long) is used to compact each layer by giving 25 strokes uniformly.

- Vibratory Compaction:

- If a vibrating table is used, the moulds are placed on the table, and vibration is applied for 30-60 seconds to remove trapped air.

c) Finishing the Surface

- After the final layer is compacted, the surface of the cube is levelled using a trowel to achieve a smooth and uniform finish.

4. Curing of Cube Specimens

a) Initial Curing (24 Hours)

- The cubes are left undisturbed in the moulds for 24 hours at a temperature of 25°C to 30°C.

- They are covered with wet gunny bags or plastic sheets to prevent moisture loss.

b) Demolding the Cubes

- After 24 hours, the cubes are carefully removed from the moulds to avoid damage.

c) Water Curing

- The cubes are immediately placed in a water curing tank filled with clean water at 27°C ± 2°C.

- The cubes are kept submerged for 7, 14, or 28 days, depending on the required test duration.



(a)



(b)



(c)

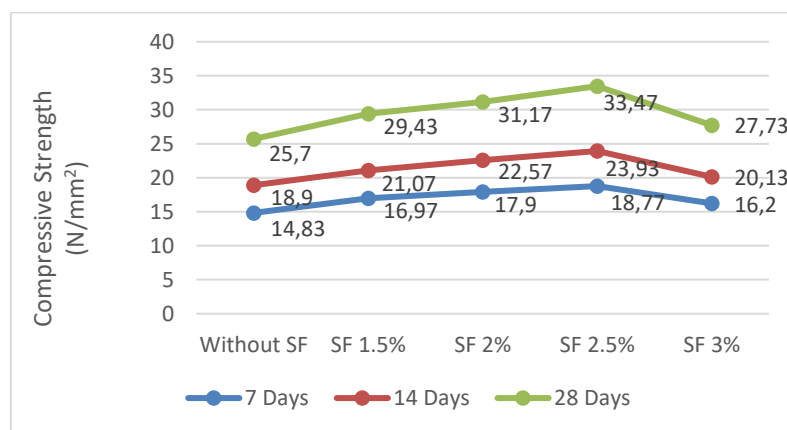
IV. EXPERIMENTAL RESULTS

4.1 Compressive strength testing results for M20

Table 4.1–Values compressive strength testing

| Dimension of cube | No. of days | Samples | | | | |
|--------------------|-------------|--|---------------------------------------|-------|-------|-------|
| | | Without Steel Fiber (N/mm ²) | With Steel Fiber (N/mm ²) | | | |
| | | | 1.5 % | 2% | 2.5% | 3% |
| 150 x 150 x 150 mm | 7 Days | 14.83 | 16.97 | 17.90 | 18.77 | 16.20 |
| 150 x 150 x 150 mm | 14 Days | 18.90 | 21.07 | 22.57 | 23.93 | 20.13 |
| 150 x 150 x 150 mm | 28 Days | 25.70 | 29.43 | 31.17 | 33.47 | 27.73 |

Above table summarizes the compressive strength values of all concrete mixes, both with and without steel fiber, to provide a comparative overview of performance across different fiber content levels.



Graph no 4.1.: Compression Strength Testing

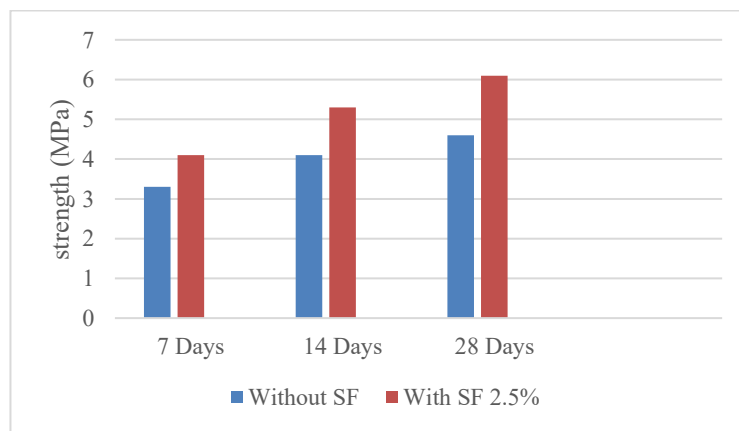
The graph illustrates the variation in compressive strength of concrete at different curing periods (7, 14, and 28 days) for varying percentages of steel fiber (SF), highlighting the optimal performance at 2.5% SF content and demonstrating the influence of fiber dosage on strength development over time.

4.2 Flexural strength testing results for M20

Table 4.2 –Values of flexural strength testing

| Dimensions | No. of days | Without Steel Fiber (MPa) | With Steel Fiber 2.5% (MPa) |
|--------------------|-------------|---------------------------|-----------------------------|
| 100 x 100 x 500 mm | 7 Days | 3.3 | 4.1 |
| 100 x 100 x 500 mm | 14 Days | 4.1 | 5.3 |
| 100 x 100 x 500 mm | 28 Days | 4.6 | 6.1 |

Above table summarizes the flexural strength values for all concrete mixes, both with and without steel fibers, to provide a comparative assessment of how varying fiber content influences the flexural performance of the concrete.



Graph no 4.2.: flexural Strength Testing

The graph compares the flexural strength of concrete with and without 2.5% steel fiber over 7, 14, and 28 days, illustrating the enhanced bending performance achieved through fiber reinforcement across all curing periods.

V. CONCLUSION

The addition of steel fibers in stamped concrete enhances its compressive strength up to an optimal level. As observed, incorporating steel fibers at 1.5%, 2%, and 2.5% significantly improves strength, making the concrete more durable, impact-resistant, and capable of withstanding higher loads. However, at 3% fiber content, the strength begins to decline, likely due to fiber clustering, poor workability, or improper bonding within the concrete mix.

Therefore, to achieve maximum strength and durability, an optimal fiber dosage (around 2% to 2.5%) should be maintained. Beyond this limit, excessive fibers may negatively affect concrete performance. This study highlights the importance of balanced steel fiber for ensuring high-strength, long-lasting stamped concrete surfaces. It seems that maximum compressive strength achieved at 28 days of curing with addition of Steel fiber is increased by 8%. Study on

the flexural strength of M20 concrete with 2.5% steel fibers was conducted at curing ages of 7, 14, and 28 days, with three specimens tested at each interval. The test results indicate a notable improvement in flexural strength due to the incorporation of steel fibers.

From the experimental data, the following observations were made:

- At 7 days, the flexural strength increased from 3.3 MPa (conventional M20) to 4.1 MPa, representing a 24% improvement.
- At 14 days, the strength increased from 4.1 MPa to 5.3 MPa, showing a 29% enhancement.
- At 28 days, the strength improved from 4.6 MPa to 6.1 MPa, exhibiting a 33% increase compared to plain M20 concrete.

The significant increase in flexural strength can be attributed to the bridging effect of steel fibers, which effectively arrests crack propagation and enhances the load-bearing capacity of the concrete. The improved performance suggests that the addition of 2.5% steel fibers enhances durability, ductility, and flexural behavior, making it a suitable material for applications requiring higher tensile strength, such as pavements, bridge decks, and industrial floors.

5.2 Future Scope of Study The present experimental investigation was confined up to evaluation of engineering Properties of the Steel-Fibers reinforced concrete and making the stamping process more cost effective. Present investigation can be extended in the future to incorporate of the following aspects which have not been incorporated in the present study.

Different types materials can also be used to make stamps to makes it more cost effective.

- Steel-Fibers other than 3D can be used.
- Different types of natural fibers can also be used.
- Ways to make stamped concrete more cost effective.
- Replacement for the colours to be used in stamped concrete.
- Different % of steel fiber can also be used to increase the strength of concrete

REFERENCES

- [1] Estrella Quennie Mae, Florencio Julia Bien, the performance of steel fiber reinforced concrete as structural elements of a seismic resistant three-story low-cost housing using SAP 2000, 2024.
- [2] J.D. Chaitanya kumar, G.V.S. Abhilash, Experimental Studies on Glass Fiber Concrete, 2016.
- [3] Lauri Hass, F.P. Bos, Characterizing the bond properties of automatically placed helical reinforcement in 3D printed concrete, 2022.
- [4] Lin Chena, Zhonghao Chen, Recent developments on natural fiber concrete: A review of properties, sustainability, applications, barriers, and opportunities, 2023.
- [5] Mohamed M. Al Rifai, Karol S. Sikora, Effect of micro steel fibers volume fraction on behavior of high-strength self-compacting concrete, 2024.
- [6] Mohammad Bakhshi, Isabel B. Valente, New model for evaluating the impact response of steel fiber reinforced concrete subjected to the repeated drop-weight, 2024.
- [7] Nitin D. Arsod, Pratik V. Kannao, A Paper on Experimental Investigation on Concrete Paver Block and Plastic Paver Block, 2019.
- [8] Nur Indah Mukharromah and Do Young Moon, Steel Fiber Orientation Efficiency Factor Model for a Magnetically Treated Cement-Based Composite, 2024.
- [9] S. Dhamodharan and M. Jayabal, Experimental Investigation on Stamped Concrete with Alkaline Resistance Glass Fibre and Colour Powder, 2018.
- [10] Shashi Raj and Rajiv Kumar, Analysis the Strength of Concrete Using Steel Fibre Reinforced, 2024.



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