IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

UTILIZATION OF LATHE STEEL FIBRE FOR DEVELOPMENT OF CONCRETE: REVIEW

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Abstract: In the domain of modern construction, concrete serves as a pivotal material with applications ranging from towering structures to pavements. The emergence of Fiber Reinforced Concrete (FRC) has ushered in a transformative era, promising comprehensive enhancement of concrete's mechanical properties. This study delves into the potential of waste lathe steel Fiber as a reinforcing agent in concrete, aligning with global sustainability goals. By augmenting tensile and compressive strength, lathe Fiber reshapes concrete into a resilient composite, offering cost-effective reinforcement while reducing environmental impact. The investigation evaluates lathe steel Fiber's practicality in M20 concrete, optimizing proportions to enhance compressive, flexural, and split tensile strength. Through systematic exploration, this research addresses gaps in understanding long-term performance, interactions with admixtures, and applicability in various loading conditions. By comprehensively assessing properties and addressing environmental concerns, this study guides future practices toward sustainable construction solutions.

Keywords: Lathe steel fiber, Concrete, Mix Design M_{20}.

1. INTRODUCTION

In the realm of modern construction, concrete stands as a fundamental material, utilized in a myriad of applications ranging from towering engineering structures to durable pavements. With the perpetual demand for concrete possessing high compressive strength and superior workability, the emergence of Fiber Reinforced Concrete (FRC) marks a transformative epoch, promising a holistic enhancement of concrete's mechanical properties. FRC offers multifaceted improvements across critical parameters including tensile strength, toughness, ductility, post-cracking resistance, and durability, addressing challenges such as shrinkage, impact resistance, and cavitation in underwater environments.

This study intricately intertwines with the global pursuit of sustainable development, exploring the transformative potential of waste lathe steel Fiber material as a reinforcing agent in concrete for diverse construction applications. Lathe Fiber, often overlooked yet readily available at minimal cost, emerges as an economically viable and environmentally friendly alternative for concrete reinforcement, optimizing material essence while reducing construction costs. By augmenting both tensile and compressive strength, lathe Fiber reshapes concrete into a more resilient and durable composite material, positioning it as a strategic component in the ongoing evolution of concrete technology.

Moreover, this research addresses waste management concerns by focusing on lathe steel Fiber generated during manufacturing processes, presenting it as an attractive substitute to conventional disposal methods and aligning with sustainable practices. The utilization of lathe Fiber extends to environmental considerations and energy efficiency, promising bolstered properties in concrete and advocating for sustainable construction practices amidst increasing waste generation.

The practicality of incorporating lathe steel Fiber into concrete is investigated, delving into compressive strength, splitting tensile strength, and flexural strength of M20 concrete while optimizing Fiber proportions. Lathe Steel Fiber-Reinforced Concrete (LSSRC) emerges as a cost-effective alternative, with physical properties closely mirroring those of conventional steel Fibers. The study emphasizes manual optimization and practicality, recognizing the accessibility and adaptability of the proposed solution in real-world construction scenarios.

Furthermore, the research extends beyond practical advantages to comprehend the effectiveness of lathe steel Fiber in enhancing concrete strength and envisions a broader impact on sustainable construction practices. By establishing a robust foundation for the integration of waste materials, the study advocates for intentional moves towards sustainable construction practices, shaping a more environmentally conscious future in the construction industry.

2. LITERATURE REVIEW

The literature review presented in this project provides a comprehensive overview of research conducted on various aspects of steel fiber reinforced concrete (SFRC) and its advantages over conventional concrete. Fifteen research papers were referred to explore the current thinking and research on this topic.

One of the studies by **Luigi Biolzi and Sara Cattaneo** investigated the response of steel fiber reinforced high-strength concrete beams. They found that the inclusion of steel fibers improved flexural strength and ductility, particularly in comparison to beams without stirrups.

Rami Eid and Patrick Paultre analyzed the compressive behavior of fiber-reinforced polymer (FRP) confined reinforced concrete columns, aiming to enhance ductility in earthquake-resistant structures. They observed an increase in axial compressive strength with the addition of FRP layers.

Jing Jun Li, Chao Jun Wan, and Yun Chao Wu conducted research on flexural toughness evaluation methods of steel fiber-reinforced lightweight aggregate concrete. Their findings suggested that an optimal dosage of steel fibers enhanced flexural strength while maintaining workability. Angelo Caratelli et al. studied the punching shear behavior of lightweight fiber-reinforced concrete slabs, revealing that the addition of steel fibers significantly increased punching resistance.

Moreover, **S.N. Pogorelov and G.S. Semenyak** examined the frost resistance of steel fiber reinforced concrete containing active mineral additives, highlighting the beneficial effects of fiber reinforcement on durability. Thiago Melo Grabois evaluated the properties of self-compacting lightweight concrete reinforced with steel fibers, noting improvements in flow time and thermal insulation.

Lastly, **Cengiz Dundar** investigated the effects of carbon fiber polymer confinement on slender plain and steel fiber-reinforced concrete columns, finding that CFRP material increased strength capacity and improved ductility in both types of columns.

Overall, these studies underscore the potential of steel fiber reinforcement in enhancing various properties of concrete, including strength, ductility, durability, and resistance to external factors like frost and punching shear loads.

3. MATERIAL AND EQUIPMENT

A. Cement

Cement is a binder, a substance used for construction that sets, hardens and adheres to other materials, binding them together. Cement is seldom used on its own, but rather to bind sand and gravel (aggregate) together. Cement is used with fine aggregate to produce mortar for masonry, or with sand and gravel aggregates to produce concrete. Ordinary Portland cement of 43 grade was used for the investigation. Figure 1 shows the cement OPC 43 grade used.

Sr no.	Characteristics	Experimental value	Specified value as per IS:8112-1989
1	Consistency of cement (%)	33%	----
2	Specific gravity	2.99	3.15
3	Initial setting time (minutes)	32	>30 As Per IS 4031-1968
4	Final setting time (minutes)	300	<600 As per IS4031-1968
5	Compressive strength (N/mm2) (i) 3 days (ii) 7 days (iii) 28days	 27.56 40.57 48.96	 >23 >33 >43
6	Soundness (mm)	0.6	10
7	Fineness of Cement	6%	10% As Per IS 269-1976.

Table No. 1 Properties of Cement

B. Aggregate

The bulk of concrete is made of aggregates. Aggregates are inert material or chemically inactive material like crushed rock, sand, broken bricks, gravel etc.

1. Fine aggregate

Fine aggregate, in the context of concrete, refers to the granular material that passes through a 4.75 mm (No. 4) sieve and is retained on a 75 µm (No. 200) sieve. It primarily consists of natural sand, crushed stone dust, or a combination of both. Fine aggregate is a crucial component of concrete mixtures, contributing to various properties and characteristics of the final concrete product. It fills the voids between coarse aggregate particles, enhancing the workability, strength, and durability of the concrete. Fine aggregate also influences the water demand, shrinkage, and surface texture of concrete, making it an essential ingredient in construction applications.

Sr. No.	IS Sieve Designation	Mass Retained on sieve (gm)	%age retained	Cumulative%age retained .c.
1	4.75mm	0	0	0
2	2.36mm	30	3.0	3.0
3	1.18mm	19	1.9	4.9
4	600µ	15	1.5	6.4
5	300µ	432	43.2	49.6
6	150µ	372	37.2	86.8
7	75µ	118	11.8	98.6
8	Pan	14	1.4	100
		∑ C		**349.3**

Table no 2: Sieve Analysis of Fine Aggregate (as per IS: 383- 1970)

2. Coarse Aggregate

Coarse aggregate refers to the portion of the aggregate mix that is larger than 4.75 mm (3/16 inch) in diameter. It typically consists of materials such as gravel, crushed stone, or recycled concrete. Coarse aggregate is an essential component of concrete, serving as the main structural filler and providing strength and stability to the mixture. Its primary function is to distribute the load evenly throughout the concrete, thereby enhancing its overall strength and durability. Additionally, coarse aggregate plays a crucial role in reducing shrinkage and improving workability during the concrete mixing process. The selection of coarse aggregate depends on factors such as availability, cost, and desired properties of the final concrete mix.

Sr. No.	IS Sieve Designation	Mass Retained on sieve (gm)	Percentage (%)retained (gm)	Cumulative Percentage (%)retained (gm)
1	80mm	0	0	0
2	40mm	250	250	5
3	20mm	1750	2000	40
4	10mm	1600	3600	72
5	4.75mm	1400	5000	100
6	2.36mm	0	5000	100
7	1.18mm	0	5000	100

8	0.6mm	0	5000	100
9	0.3mm	0	5000	100
10	0.15mm	0	5000	100
∑C				**717**

Table No. 3: Sieve Analysis for Coarse Aggregate

3. Fibre's:

Scrap steel of 0.5 mm diameter has been used in the preparation of SFRC. The fibre of 40mm in length has been used giving optimum aspect ratio of 80 The properties of fibers are given in Table 2

SR.NO	Tensile Strength	Young's modulus	Specific Gravity	Length of Fibre	Diameter of Fibre	Aspect Ratio
1	360 Mpa	2.05×10^4Mpa	7.8	45mm	0.6 mm	75

Table 4: Properties of fibres used

4. OBJECTIVE OF STUDY

The primary objective of this research is to investigate the properties of concrete when incorporating steel fibers obtained from various lathe operations. Considering the significant waste generated in lathe shops in the form of steel fibers, utilizing these fibers in concrete presents an economical and sustainable approach. This integration not only enhances concrete quality but also reduces cement content while improving workability and mechanical properties. In this study, steel fibers with a diameter of 0.6 mm and a length of 45 mm were utilized in varying percentages (0%, 0.5%, 1%, 1.5%, 2%, 2.5%) by the weight of M20 grade concrete with a water-cement ratio of 0.42. The analysis indicates that these steel fibers effectively enhance compressive, flexural, and split tensile strength of the concrete. Additionally, straight steel fibers are observed to further improve concrete properties. Notably, the steel fibers obtained from lathe operations exhibit an optimum dosage of 2% by weight, resulting in significant enhancements in compressive strength (15%), flexural strength (30%), and split tensile strength (42%).

- To assess the influence of lathe steel fiber on the compressive strength of Grade M20 concrete.
- To investigate the flexural strength and ductility characteristics of M20 concrete with varying percentage of lathe steel fiber.
- To analyze the durability aspects, including resistance to environmental factors and long-term performance

5. SCOPE AND IDENTIFYING RESEARCH GAP

The study investigates the properties of Grade M20 concrete with lathe steel fiber, aiming to determine the optimal percentage of fiber content for achieving the best combination of properties, such as compressive strength, flexural strength, and durability. However, a research gap exists in understanding the long-term performance of M20 concrete with lathe steel fiber, particularly in terms of factors like durability, resistance to environmental conditions, and potential degradation of fibers over time. Additionally, the study does not explore the potential interactions between lathe steel fibers and other commonly used admixtures in concrete, nor does it cover the concrete's behavior under various loading conditions. Furthermore, there's a lack of optimization for specific applications or structural elements and limited insight into the impact of lathe steel fibers on the workability of fresh concrete and construction practices. Additionally, the study falls short in conducting a comprehensive cost-benefit analysis and addressing the environmental impact of incorporating lathe steel fibers into concrete. By addressing these research gaps, a more thorough understanding of the performance, applicability, and optimization of M20 concrete with lathe steel fiber can be achieved, thus guiding future practices in the construction industry.

6. PROBLEM FORMULATION

The introduction highlights the growing interest in fiber reinforcement for concrete and its potential to enhance mechanical and durability properties. This study specifically focuses on evaluating Grade M20 concrete properties with the addition of lathe steel fiber, aiming to address specific challenges and opportunities in construction applications. The background section provides a brief overview of the importance of concrete reinforcement, emphasizing the role of fibers in enhancing tensile strength, ductility, and crack resistance. It also outlines existing literature on steel fibers and their impact on concrete properties, emphasizing research gaps and the need for further investigation. The research objectives are clearly stated, including assessing the influence of lathe steel fiber on compressive strength, investigating flexural strength and ductility characteristics, and analyzing durability aspects such as resistance to environmental factors and long-term performance. The research questions are outlined to guide the study, focusing on the effects of lathe steel fiber on compressive strength, optimal dosage for improved flexural strength and ductility, and its contribution to concrete durability in various environmental conditions. Lastly, the scope of the study is defined, indicating a focus on Grade M20 concrete due to its widespread use in construction projects.

7. CONCLUSION

In conclusion, this research paper has explored the transformative potential of incorporating waste lathe steel Fiber into concrete to enhance its mechanical properties and sustainability. By investigating the influence of lathe steel Fiber on Grade M20 concrete, this study has provided valuable insights into the optimization of concrete mixtures for improved compressive, flexural, and split tensile strength. The findings suggest that the inclusion of lathe steel Fiber offers a cost-effective and environmentally friendly solution to reinforce concrete structures while reducing construction costs and waste generation.

However, several research gaps and opportunities for future investigation have been identified, particularly regarding the long-term performance, interactions with admixtures, and environmental impact of incorporating lathe steel Fiber into concrete. Future research endeavors should focus on addressing these gaps to further enhance our understanding of sustainable construction practices and optimize the utilization of waste materials in concrete production.

Overall, this research contributes to the ongoing evolution of concrete technology and advocates for the integration of sustainable practices in the construction industry. By embracing innovative solutions like lathe steel Fiber reinforcement, we can pave the way for a more resilient, cost-effective, and environmentally conscious future in construction

REFERENCES

1. Biolzi L. et al. (2016), “Response of steel fiber reinforced high strength concrete beams: Experiments and code predictions,” Cement and Concrete Composites, Vol. 77, 1-13, Elsevier.
2. Eid R. et al. (2016), “Compressive behaviour of FRP confined reinforced concrete columns”, Engineering Structures, 132, 518-530.
3. Li J. J. et al (2016), “Investigation on flexural toughness evaluation method of steel fiber reinforced lightweight aggregate concrete”, Construction and Building Materials, 131, 449-458.
4. Carate li A. et al (2016), “Punching shear behaviour of lightweight fiber reinforced concrete slabs”, Composites Part B, 99 , 257-265.
5. Pogorelov S. N. et al (2016), “Frost Resistance of the Steel Fiber Reinforced Concrete Containing Active Mineral Additives”, International Conference on Industrial Engineering, Procedia Engineering, 150, 1491-1495.
6. Grabois T. M. et al (2016), “Fresh and hardened-state properties of self-compacting lightweight concrete reinforced with steel fibers”, Construction and Building Materials, 104, 284-292.
7. Dunar C. et al (2015), “Studies on carbon fiber polymer confined slender plain and steel fiber reinforced concrete Columns,” Engineering Structures, 102, 31-39.

8. Kim J. et al (2015), "Evaluation of mechanical properties of steel fibre reinforced concrete exposed to high temperatures by double punch test", Construction and Building Materials, 79, 182-192.
9. Karadelis J. N. et al (2015), "Flexural strengths and fibre efficiency of steel fibre reinforced, roller compacted, Polymer modified concrete," Construction and Building Materials, 93, 498-505.
10. Xie T. et al (2015), "Behaviour of steel fiber reinforced high strength concrete filled FRP tube columns under axial compression," Engineering Structures, 90, 158-171.
11. Patil S. et al (2014), "Study of Flexural Strength in Steel Fibre Reinforced Concrete", International Journal of Recent Development and Engineering and Technology, Vol. 2, Issue 5, 13-16.
12. Harle S. et al (2014), "Steel Fiber Reinforced Concrete & Its Properties", International Journal of Engineering Sciences and Research Technology, 30-32
13. Gadge N. A. et al (2013), "Mix Design of Fiber Reinforced Concrete (FRC) Using Slag & Steel Fiber", International Journal of Modern Engineering Research, Vol. 3, Issue 6, 3863-3871.
14. Vishnuram B. G. et al (2013), "Studies on Steel Fibre Reinforced Concrete – A Sustainable Approach", International Journal of Scientific and Engineering Research, Vol.4 , Issue 5 May 2013, 1941-1944.
15. Choi S. Y. et al (2011), "A Study on the Shrinkage Control of Fiber Reinforced Concrete Pavement,"12 East Asia – Pacific Conference on Structural Engineering and Construction, Procedia Engineering 14 , 2815-2822.
16.Bureau of Indian Standards (1996), " Method of Physical Test for Hydraulic Cement, Part 1, Determination of Fineness by Dry Sieving," Indian Standards 4031 (Part 1):1996, Second Revision.
17. Bureau of Indian Standards (1988), " Method of Physical Test for Hydraulic Cement, Part 1, Determination of Soundness", Indian Standards 4031 (Part 3) : 1988 , First Revision
18. Bureau of Indian Standards (1970), "Specification for Coarse and Fine Aggregates from Natural Resources for Concrete," Indian Standards 383:1970 , Second Revision, Table 4.
19. Bureau of Indian Standards (1970), " Method of Physical Test for Hydraulic Cement," Indian Standards 4031 (Part 6) : 1988, First Revision, Clause 6.1.2.