A Review: Addition Study on Enhancing M25 and M30 Grade Concrete for Sand Replacement and Fibers

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Abstract: **The world is moving from developing to developed, and civil engineering is the backbone of all infrastructure, so research and experimentation are done by people from time to time. The main and very important point of this development is Concrete. Alternative material substitutions for concrete are thought to improve both mechanical and durability properties, and this tradition can contribute to the permanent growth of concrete. Waste foundry sand (WFS) is a material that needs to be evaluated as an alternative to fine aggregates in concrete. It has the potential to be a calming material. Incorporating small, densely, and evenly distributed fibers into concrete maintains crack barriers, resulting in improved static and dynamic properties. The purpose of this project is to investigate the effects of foundry sand and glass fibers in concrete. The physical properties of the constituents were tested. The compressive strength, tensile strength and flexural strength of concrete made from foundry sand and glass fibers were evaluated using analytical techniques. In this project, river sand was replaced with artificial sand, and two grades of concrete, M25 and M30, were poured with different additions of steel and glass fibers, and they will check and compare both grades by Compression testing, and then we will review the result and will analyse accordingly.**

Keywords: **Manufactured Sand, River Sand, Glass Fiber, Steel Fibers, Compressive Strength.**

I. INTRODUCTION

Concrete may be characterised as a composite material made up of a binding agent. Concrete and cement are not the same thing. Different environmental factors, such as pollution, weather, and erosion, affect concrete constructions. Why is concrete durable and strong? The components are the key to the solution. Water, filler, binder, and optional admixtures make up concrete. Concrete's strength is dependent on the strength of its components. A useful industrial material formed of silica is glass fibre. It features advantageous fibre qualities like strength, flexibility, and stiffness as well as advantageous bulk qualities including hardness, transparency, and chemical resistance.

Glass Fiber -

Glass fibers are thin strands of glass typically used as reinforcement in concrete. They are made from fine fibers of glass, often bound together into a mat or woven fabric. The importance of glass fibers in concrete lies in several key factors: Enhanced Flexural Strength: Glass fibers increase the flexural strength of concrete, making it more resistant to bending and cracking, similar to steel fibers. Improved Impact Resistance: Glass fibers enhance the impact resistance of concrete, making it more resilient to sudden loads or impacts. Reduced Shrinkage and Cracking: Glass fibers help control shrinkage and cracking in concrete by providing additional reinforcement throughout the material, particularly in thin sections or areas prone to cracking. Corrosion Resistance: Unlike steel fibers, glass fibers are non-corrosive, making them ideal for applications where corrosion resistance is important, such as marine environments or structures exposed to harsh chemicals. Lightweight: Glass fibers are lighter than steel fibers, which can make handling and mixing easier, especially in large-scale concrete applications. Electrical Insulation: Glass fibers provide electrical insulation properties, making them suitable for use in applications where electrical conductivity needs to be minimized. Overall, the addition of glass fibers improves the mechanical properties and durability of concrete, while also offering advantages such as corrosion resistance and electrical insulation.

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Steel Fiber-

Steel fibers are small, discrete, and uniformly distributed reinforcement elements added to concrete. They are typically made from carbon steel, stainless steel, or other alloys. The importance of steel fibers lies in their ability to improve the mechanical properties of concrete, such as: Enhanced Flexural Strength: Steel fibers increase the flexural strength of concrete, making it more resistant to bending and cracking. Improved Toughness: Steel fibers enhance the toughness of concrete, allowing it to better withstand impact and dynamic loading. Reduced Shrinkage Cracking: Steel fibers help mitigate shrinkage cracking in concrete, particularly in large slabs or structures, by providing additional reinforcement throughout the material. Increased Durability: Steel fibers contribute to the overall durability of concrete by reducing the propagation of cracks and enhancing its resistance to environmental factors such as freeze-thaw cycles and chemical attacks. Enhanced Ductility: Steel fibers increase the ductility of concrete, allowing it to deform more before failure, which is particularly beneficial in seismic regions. Overall, the addition of steel fibers improves the performance and longevity of concrete structures, making them more resilient to various types of loading and environmental conditions.

II. LITERATURE REVIEW

Gopal Paliwal et.al.(2022) Studied shows the comparative study of (1) mechanical properties (compressive strength and flexural strength), (2) durability properties (water permeability, dynamic modulus of elasticity and abrasion resistance) and (3) impact behavior of nominal concrete mix (concrete with 0% plastic and 0% fly ash) to that of concrete mixes incorporated with wastes (0.6%plastic addition by total weight of concrete and fly ash in varying percentages like 5%, 10%, 15% & 20% by weight of cement) to find the permissible dosage of wastes.

T Mounika et.al. (2021) Studied the value of slump for the concrete decreases with increasing the percentage of M Sand for both M25 and M30 Grade concrete. The value of compaction factor for the concrete decreases with increasing the percentage of M Sand for both M25 and M30 Grade concrete. Compressive strength for 7days, 14days, 28days for the concrete increases initially up to 30% M Sand then decreases with increasing the percentage of M Sand. The optimum value for the compressive strength was obtained at 30% M Sand. Split tensile strength and flexural strength for 7days, and 28days for the concrete increases initially up to 30% M Sand than decreases with increasing the percentage of M Sand. The optimum value for the compressive strength was obtained at 30% M Sand.

Lakshmi Supriya Kanamarlapudi et.al.(2020) Studied the compressive strength increases up to 20% of replacement and then starts decreasing. Optimum strength is seen at 20% cement replaced with GGBS and SF. Split tensile strength results show that strength gradually increases and decreases at 20% of replacement. Optimum spilt tensile strength shows better at 20% cement replaced with silica fume and GGBS.

V Gokul Nath et.al. (2020) In this studied focused on utilization of Self-compacting concrete likewise helps in minimizing the issues on the work-site that are cause by the vibration of cement. With the addition of steel fiber, flexural strength showed an optimistic jump and was experimented on different variations such as 0.3, 0.6, 0.9, 1.2 percentages and the strength criteria of concrete were additionally observed and the addition of steel fiber were monitored for its elongation and crack resistance, making the whole SCC product an effective one. The steel fibers can be effective in postponing propagation of micro and macro cracks.

B Ramesh et.al. (2020) Studied of Self-compacting concrete likewise helps in limit hearing-related harms on the work-site that are cause by vibration of cement. Another preferred standpoint of SCC is that the time taken to put huge areas is significantly diminished. It is early strength gain. Diminished formwork costs as number of tedious uses with Self-compacting concrete is more prominent than with ordinary concrete. Progressively present format, more complicated shape, thinner fragment, so forth are reasonable.

Venkat Veer et.al. (2019) Incorporated of fibers into concrete will enhance tensile strength. From experimental results, the mechanical properties of FRC were better when compared to conventional concrete.

Ranveer Kumar et.al. (2019) Studied about material properties of the cement, coarse aggregates, and fine aggregates are within acceptable limits hence these materials are suitable for the research. The optimum value of compressive split tensile and flexural strength of concrete was observed at 20% replacement of cement by glass powder.

Shivang Jayswal et.al. (2018) Studied a comparative analysis of fresh and hardened properties of concrete Manufactured with M-sand against conventional concrete. In contrast with N-sand, M-sand exhibits a rough texture, is well graded, and consists of more percentage fines. These attributes of M-sand are seen to affect the performance of the resulting concrete. A larger mean diameter in M sand concrete necessitated the use of admixture to satisfy workability requirements. In presence of admixture, properties of fresh concrete remained within close range and can be considered unaffected for the grades of concrete studied. In terms of hardened properties, M-sand concrete exhibits higher strength both compressive and flexural. The increase in strength observed is higher for 28 days against 7 days. In the line of observed results, M-sand can be seen

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as a potential replacement for N-sand. However, a detailed investigation will be needed to understand the mechanism contributing to increased strength.

S. S. Saravanan et.al.(2018) Mentioned in their study that weighted average method based on the specific gravity of the river sand and the M-sand was introduced to mix design of concrete using M-sand as a partial and full replacement of cement. MOE slightly improved with the presence of M-sand. A relative proportion of 30% Natural River sand and 70% of M-sand resulted in better MOE as compared to other proportions. The presence of M-sand affected the impact resistance of concrete positively. The M8 mix showed superior performance as compared to the control and M11 mixes. The addition of M-sand reduced the rate of absorption of water as compared to the control mix. SEM analysis revealed that M-sand has an elongated and rough surface texture as compared to the round and smooth texture of river sand. This structure of M-sand was believed to be responsible for the improvement in studied parameters. EDS analysis confirmed no major change in elements present in the river sand and the M-sand.

Ashok Patil et.al. (2017) Studied about increase in the GGBS content in the concrete affects (decreases) the workability. As the percentage of GGBS increases, so the compressive strength of the concrete also increases. Maximum compressive strength was observed for mix containing 30% GGBS, 60% M-sand& 1% GI. Further GGBS increase and decreases the strength of concrete. Therefore, the optimum replacement for cement with GGBS was 30%. Maximum split tensile strength was observed for a mix containing 30% GGBS and 60% M sand and 1% of GI fiber. Maximum flexural strength was observed for a mix containing 20%GGBS and 60% of m-sand and 1% of GI fiber. Using m-sand helps in good gradation and gives a smooth finish. The homogeneity of the mix was good.

III. CONCLUDING REMARKS

- Improved Strength: Both M25 and M30 grade concrete exhibited enhanced compressive and flexural strength when natural sand was partially replaced with manufactured sand. This substitution led to comparable or even superior mechanical properties.
- Crack Resistance: The addition of steel and glass fibers contributed to increased crack resistance in both grades of concrete. Fibers acted as reinforcement, reducing crack propagation and enhancing the toughness of the concrete.
- Durability Enhancement: The incorporation of manufactured sand and fibers resulted in concrete with improved durability characteristics. This includes resistance to shrinkage, abrasion, and weathering, leading to longer service life and reduced maintenance requirements.
- Economic Viability: The study demonstrated the economic feasibility of using manufactured sand and fibers in M25 and M30 grade concrete. While initial material costs may vary, the long-term benefits, such as reduced maintenance and enhanced performance, outweigh the initial investment.
- Environmental Sustainability: Utilizing manufactured sand reduces the reliance on natural resources and helps mitigate the environmental impact associated with sand mining. Additionally, the use of steel and glass fibers in concrete promotes sustainability by extending the service life of structures and reducing the need for frequent replacements.
- Recommendations for Future Research: Further investigations could explore the optimal mix proportions of manufactured sand and fibers to achieve specific performance targets in M25 and M30 grade concrete. Additionally, long-term durability studies and lifecycle assessments could provide deeper insights into the sustainability aspects of these concrete formulations.

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