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EXPERIMENTAL RESEARCH ON THE STRENGTH OF MODIFIED CONCRETE WITH STEEL WASTE FIBER AND PARTIAL REPLACEMENT OF GRANITE REFUSE WITH COARSE AGGREGATE A REVIEW

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ABSTRACT

A novel structural substance that is acquiring significance is fiber-reinforced concrete (FRC). Numerous technical characteristics of concrete are enhanced by the discrete addition of fibers reinforcement. A very little study using this novel material is currently being done in the Kingdom. This article discusses the various fiber varieties and the applications of FRC in various fields. Additionally, it displays the outcomes of studies on the mechanical characteristics of FRC using locally accessible straight and hooked steel strands. There have been numerous efforts to incorporate industrial waste materials like fly ash, silica fume, GGBS, metakaolin, and copper slag into concrete, which have had a significant impact on the material's mechanical and durability characteristics. Numerous reliable studies have documented the value of steel strands in enhancing the flexural strength of concrete. In this study, waste glass powder (WGP), which has been used as a fine aggregate replacement in concrete at various percentages of 0%, 3%, 6%, 9%, 12%, and 15%, is combined with recycled steel fibers (RSF).

I. INTRODUCTION

The construction industry has become one of the wide areas of research, particularly in the field of concrete technology. Nowadays, the need for basic infrastructure in urban areas led to an increase in developmental activities throughout the globe for which there is a huge demand for concrete, posing a major threat to the environment due to the emission of higher levels of greenhouse gases such as carbon dioxide. The practice of incorporating industrial waste materials has gained tremendous attention in the field of research to develop greener and more sustainable building materials. In India, more than 300 tons of waste glass is disposed of daily in the form of glass bottles from beverage factories and the form of glass sheets from ceramics industries. The disposal of huge quantities of glass as waste is a serious threat to the environment. To bring out a solution to this, inthe past ten years many recycling methods were adopted to reuse the waste glass again. About 75% of the volume of concrete is usually made up of aggregates, which are important for the concrete's workability, strength, dimensional stability, and longevity sand andserve as the fine aggregate in conventional concrete, while large aggregate is made up of gravel, limestone, or granite in a variety of sizes and forms. A lot of studies are being done on the use of numerous materials, including coal ash, steel slag, and blast furnace slag, as aggregate replacements. There is increasing interest in using waste materials as alternative aggregate materials. This kind of refuse material can be building locations that lack gravel and can lessen environmental issues associated with waste dumping and digging for aggregate. As a by-product of the production of iron and steel, steel slag is created. The primary by-product of the fundamental steel-making operations, which convert iron to steel, is significant amounts of steel slag (Cement Australia Group). In beds, the steel slag produced during the conversion of iron to steel is spilled and gradually cooled by atmospheric temperatures. Slag consumption in concrete contributes to creating an environmentally favorable substance as well as lowering greenhouse gas emissions. The use of steel slag can lessen the need for native rock building sing.In India, where it has been claimed that nearly 760 million tires are routinely discarded as waste from vehicle mechanic repair sheds and the automobile industries each year, waste tires also make up a significant portion of the country's solid waste. Today, recycled waste tires are used to create a few raw materials, such as steel filaments, rubber fibers, and rubber powder, that can be added to concrete to increase its strength. Thus, used tires from local mechanic repair shops were gathered and processed to create the recycled steel fibers used in the current paper.

II. ADDITION OF STEEL WASTE FIBER AND ALTERNATIVE USE OF GRANITE WASTE

Many studies have been done in the past to examine the real behavior of recycled steel strands in concrete. Listed below are a few evaluations. In their extensive study,

[1] Simalti et al.tried to examine the strength and durability of concrete reinforced with recycled steel fibers (RSF) derived from waste tires and manufactured steel fibers (MSF), respectively, in varying amounts of 0%, 0.5%, 1%, and 1.5%. In comparison to MSF, it was claimed that the concrete blend that had 1.5% RSF added to it performed better overall.

[2]Zhong and Zhang,The workability, strength, and longevity of concrete reinforced with recycled tire steel fibers (RTSF) and polypropylene strands were studied through experiments It was discovered that the workability was enhanced by 38.9–66% by the combination blend of RTSF and PPE. The composite reinforcement's greater RTSF content improved the concrete's crack resilience. Similar to this, the findings showed that the hybrid reinforcement's greater PPE content decreased chlorine ingression by 4.9–6.8%.

[3]Samindi et *al*. presented the results of a thorough investigation into the mechanical behavior of concrete reinforced with recycled steel fibers derived from waste tires. The findings were compared to those of concrete mixes reinforced with manufactured steel fibersto gauge the potential of recycled steel fibers versus manufactured steel fibers for producing sustainable concrete.

[4]Gul and Naseer (2019),compared the findings from concrete mixtures reinforced with made steel fibers to the experimental study on the impact of recovered rubber steel fibers (RRSF) addition on the compressive, split, and flexural strength of concrete. For 1% of RRSF by volume, it was found that the addition of recovered steel fibers decreased the compressive and split tensile behavior of concrete by 20% and 14%, respectively. Later, with increased RRSF addition, the power significantly dropped. However, the outcomes showed that RRSF outperformed synthetic steel fibers in terms of improving the bending behavior of concrete.

[5]Liew and Akbar(2020), gave a thorough inquiry report on the use and importance of recovered steel fibers obtained from used tires as one of the best inexpensive and environmentally friendly reinforcing components in the manufacture of sustainable concrete. The comprehensive analysis of the mechanical, resilience, workability, porosity, bulk density, volumetric stability, and toughness of recycled steel fiber concrete was given in the trial results.

[6] Isa et *al*. (2020) intended to create ultra-high performance concrete (UHPC) that was both affordable and environmentally friendly by incorporating recycled tire steel fibers (RTSF) and recycled tire steel chords (RTSC) in greater amounts of 2%, 3%, and 4%. The results showed that adding more RTSF and RTSC significantly decreased the structural strength, which strongly suggests that adding less steel should be done to increase strength. Additionally, the research demonstrated that concrete mixes with RTSF helped create concrete that was more affordable and sustainable.

[7] Belouadah et *al.*(2019)It was also suggested creating new, inexpensive construction materials by using glass and marble powder in place of some cement, and experimental research on cement mortar's physical and mechanical properties was done. The outcomes showed that the 10% replacement amount of glass powder with cement performed the best.

[8]Jain et *al.*(2020)evaluated the durability qualities of concrete with the usage of glass powder (GP) and granite powder (GrP), replacing cement and sand in different percentages. The durability of concrete was found to be significantly enhanced by a combined mix of 15% GP and 30% GrP, according to the results.

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III. EXPERIMENTAL INVESTIGATION AND METHODOLOGY

2.1Cement: The main ingredient in the creation of concrete, cement serves as a solid cementing substance. Because of its adhesive and cohesive character, cement joins all the other raw materials to create a strong connection, which is one of its essential qualities. It uses regular Portland cement of grade 53, which has good physical and molecular characteristics.

2.2 Fine Aggregate:

The categorization of fine gravel according to Indian Standard IS:383 divides it into four zones. According to the sieve analysis results in Table 3, the used sand has a gradation profile and physical characteristics that place it in Zone II.

2.3 Coarse aggregate:

Another crucial raw material that contributes to the volume and toughness of concrete is a coarse aggregate that passes through a 4.75-mm IS filter. According to IS: 383, single-sized crush angular coarse aggregates with a minimum dimension of 20 mm are used as the coarse aggregate, which is supported by the sieve analysis result displayed in Table 5. The gradient curve's structural characteristics.

2.4 Water:

Due to its hardness, ordinary stream water does not work well for combining because it includes a variety of acids, alkalis, and organic impurities that lower the quality of concrete. Usually speaking, clean water is preferable. It serves as a lubricant, and the chemical interaction between cement and water is subsequently brought about as a result. Water from a standard faucet is used in this project.

2.5 Recycled steel Fibres:

Waste tires were used to remove recycled steel strands with an aspect ratio of 50, 30 mm length, and 0.5 mm thickness, which were then used as reinforcing components in the concrete mix. Tire scraps and steel strands that have been removed from tires.

1.6.1 Mix Design:

Concrete mix design involves a process of preparation in which a mix of ingredients creates the required strength and durability for the concrete structure. Because every ingredient in the mix consists of different properties, it's not an easy task to create a great concrete mix.

IV. CONCLUSIONS

The utilization of waste glass powder and recycled steel fibers in concrete mixes has resulted in increased compressive, flexural, and split tensile strength for both 7 days and 28 days of curing.Higher fractions of recycled steel fibers, such as 0.5%, 1%, and 1.5%, significantly increased the flexural and split tensile strength of all concrete mixtures, but the incorporation of 1% of recycled steel fibers showed better performance in terms of flexural, split tensile, as well as compressive strength.A concrete mix with 1% inclusion of RSF and 9% WGP showed the best overall performance in terms of flexural strength, with a rise in strength of 22.31% over the control specimen after 28 days of the curing period. All concrete mixes with 0% inclusion of recycled steel fibers exhibited the least flexural strength, which increased gradually with the further inclusion of higher fractions of steel fibers.A concrete mix with 1% RSF and 9% WGP inclusion reported the highest split tensile strength with an increase of 38.64% over the control specimen after 28 days of the curing period, while all concrete mixes with 0% inclusion of recycled steel fibers exhibited the least split tensile that gradually increased with further inclusion of higher fractions of steel fibers.

V. FUTURE SCOPE OF THE WORK

Utilization of waste material in concrete.Alternative use of granite construction waste concerningcoarse aggregate.Fiber steel waste fiber can be added to increase the tensile strength in the future or per study.Quarrying and extraction of stones will be reduced by recycling stones and gravel. Ecological disruptions will be lessened, saving the surface of the planet. The capacity of the land for refuse disposal will be enhanced to preserve the conventional natural aggregate for other essential works.

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