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Analysis of Lightweight Scrap Rubber Aggregate Concrete Beams Based on Elasticity: A Review

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ABSTACT:

A crucial component of building, concrete is typically made up of coarse and fine particles, both of which are getting harder to find. Adopting sustainable techniques in the building industry is essential as industrial waste builds up and the world's natural resources continue to decrease. Using industrial byproducts in place of natural aggregates in concrete is a potential strategy. Waste rubber from old tires is one such by-product, and because of disposal concerns, it presents serious environmental problems. Scrap rubber exhibits potential as a substitute for lightweight concrete due to its elasticity, energy-absorbing qualities, and reduced weight. The goal of this project is to reuse tire waste in order to lessen dependency on natural aggregates. The research uses the Method of Initial Functions (MIF), an elasticity theory-based technique, to assess the performance of concrete beams using scrap rubber tire aggregates. In contrast to conventional approaches that depend on simplifying assumptions, MIF provides accurate answers for complicated situations and yields more dependable outcomes.

Keywords: Lightweight Scrap Rubber, Concrete, Aggregates, Cement, Sand, Coarse Aggregate

1. INTRODUCTION

The most used building material in the world is concrete, which is mostly composed of cement, sand, and coarse aggregate. Concrete usage must be optimized in order to support sustainable development. In an effort to develop more environmentally friendly alternatives, recent projects have investigated the use of micro silica, a waste product that improves the strength, workability, and durability of concrete.

Concrete is essential to building and is needed in huge amounts, yet coarse and fine aggregates are scarce in some areas. The need of adopting sustainable methods in the building business is highlighted by the worldwide depletion of natural resources and the rise in industrial waste. This involves using industrial byproducts in place of natural resources when making concrete.

Significant disposal and environmental concerns are brought up by the expanding problem of rubber tire trash. Scrap rubber can be used as a substitute material to make lightweight concrete because of its elastic qualities, low density, and capacity to absorb energy. The goal of this study is to conserve aggregates by incorporating waste materials.

The MIF method is used in the study to assess concrete beams that contain recycled rubber tire particles. Compared to conventional assumption-based methods, this analytical methodology, which is based on elasticity theory, produces more dependable results by accurately solving a variety of problems without depending on assumptions about beam behavior.

1.1 Method of Initial Functions

Without making any assumptions about the distributions of stress and strain, the Method of Initial Functions (MIF) is an analytical method for resolving structural issues in elasticity theory. In order to get precise answers, it entails choosing initial functions that reflect stress or strain, entering them into the governing elasticity equations, and solving the equations. MIF may be applied to materials with different properties and is particularly helpful for studying complicated structures like orthotropic beams, plates, and shells. Compared to other techniques like finite element analysis (FEM), it can be computationally complex even though it yields accurate findings.

2. Literature Survey

1. Patel Rakesh, Dubey S.K and Pathak K.K : In the context of beams, the method is applied to solve the governing equations of an orthotropic beam (a beam with different material properties in different directions). The paper specifically presents numerical solutions for a simply supported orthotropic beam, showing how MIF can be used to determine the beam's behaviour under load. The key advantage of MIF is that it can be used to solve complex

problems in structural engineering such as in plates, shells, and beams—with high accuracy. It's especially useful for analyzing thick, sandwich, and layered beams, which might be difficult to analyze using traditional methods. Unlike many standard methods that rely on simplifying assumptions (like the nature of stress or strain), MIF provides a more direct, exact solution based on elasticity theory.

2. KM Kotresh, MG Belachew: With about 1.2 billion trash tires produced annually worldwide, disposing of them has grown to be a major waste management concern. Only 4% of these tires are used in civil engineering projects; the majority are either exported, landfilled, hoarded, or illegally discarded. The purpose of this study is to investigate if waste tire rubber may be used to partially substitute coarse aggregate in concrete composites, particularly for M25 grade concrete. In order to do this, leftover tire rubber was used to replace 10%, 20%, and 30% of the coarse aggregate in the casting of 24 concrete cubes and 12 prisms. These tyre-modified concrete samples' performance was then contrasted with that of ordinary M20 grade concrete. To assess the effect of replacing tire rubber on concrete qualities, tests were conducted on both fresh and hardened concrete strengths. Both the manufacturing of environmentally friendly concrete for use in civil engineering projects and the disposal of discarded tires may find a sustainable solution in the findings.

3. GN Kumar, V Sandeep, C Sudharani : The use of recycled tire rubber in place of fine and coarse aggregates in concrete mixtures is investigated in this research. The rubber from the tires used in the study comes from used truck tires that have undergone a mechanical grinding procedure. The possibility of incorporating this recycled rubber in concrete has long been being studied by researchers, and the resultant substance, known as "Rubcrete-Mix," has showed promise for a number of engineering uses. In addition to being an efficient method of recycling tires, it also has good mechanical qualities, which makes it a cost-effective and environmentally friendly substitute for conventional concrete aggregates.

3. CONCLUSION

In order to support the study of lightweight concrete beams constructed from scrap rubber aggregates, previous writers have gathered data and carried out experimental research, as this paper's review of pertinent articles and journals makes clear.

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