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A Review on Transparent Concrete: A Novel Material to Explore Construction Sector

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Abstract: Nowadays, the space between building is reduced due to globalization and the construction of high-rise buildings. This leads to increase in the use of non-renewable energy sources, thus, and there is a requirement of new construction technique like green buildings and indoor thermal system. This project focuses on the development and evaluation of transparent concrete, a novel construction material that incorporates light- transmitting optical fibers into a standard concrete matrix. This project aims to develop and analyze transparent concrete as a sustainable and functional construction material. The primary goals are to harness natural daylight to reduce artificial lighting costs in buildings, and to integrate smart sensing capabilities using optical fibers for structural health monitoring. This research will evaluate the mechanical performance of transparent concrete by testing its compressive and tensile strengths, comparing various mix designs including those with different percentages of optical fibers or partial cement replacement with glass powder. Additionally, the project will quantify the material's light-transmitting properties to assess its efficiency in daylighting applications, such as for facade materials, partition walls, and interior cladding. The findings will provide data on the material's viability for both aesthetic and structural purposes, contributing to the development of smart and green building technologies.

Keywords: Light Transmissive, Eco-friendly concrete, Architectural Aesthetic, Stress sensing, Green Architecture Transparent concrete, optical fibres, glass powder, Cement, Sand, Concrete, Glass fibres, Translucent Concrete, Light transmitting Concrete, Energy Saving, Material, Sustainable Concrete, Optical Concrete, Compressive Strength, Tensile Strength.

I. INTRODUCTION

Transparent concrete, also known as translucent concrete or light-transmitting concrete, is a novel material that blends the structural integrity of traditional concrete with the aesthetic and functional benefits of light transmission. This project investigates transparent concrete not only for its decorative applications in interior and exterior design but also for its potential in creating sustainable "green buildings" by reducing the need for artificial lighting during the day. Unlike traditional concrete, it incorporates optical fibers or glass rods into the mix, enabling it to transmit light, shadows, and even colors through its structure. This project explores the development and properties of transparent concrete as a viable and advanced building material for future projects. Optical fibre have very good light guiding and sensing capability. Transparent concrete enhances the building's visual appeal, making it fashionable in recent years. When many buildings are stacked close to each other, there is not much natural sunlight passing through and the importance of natural sunlight is pretty well known. Translucent concrete comes in as a best solution for easier day lighting. The light is conducted through the walls from one end to the other. Therefore, the fibres have to go through the whole object.

II. LITERATURE REVIEW

Concrete has been widely used in construction industries. Due to globalization small buildings are replaced with high rise buildings this results the lack of natural light due to obstruction of nearby building. The new technology of transparent concrete based on the nano optical fibers. The use of optical fiber in concrete makes it transparent and aesthetically pleasant. Optical fibers are one which helps for transmission of light through fiber. Also, transparent concrete is structurally stable when it compared to conventional concrete. In this study the compressive strength of transparent concrete was compared to conventional concrete to find out the strength of transparent concrete.

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III. METHODOLOGIES

Preparation of mould: A mould (e.g., wood or steel) of the desired shape and size is prepared. Holes are precisely drilled into two opposite sides to allow for the organized placement of the optical fibers.
Placing of optical fibers: The optical fibers are cut to size and carefully threaded through the holes in the mould plates. They are typically arranged in an organized, parallel, or sometimes a grid pattern to maximize light transmission. Clay or mud may be used at the sides to facilitate easy demoulding.

Mixing: The fine-grain concrete mixture is prepared by combining cement, fine aggregates, and water in the appropriate proportions **Casting:** The concrete mix is poured into the mould slowly and carefully to avoid disturbing the pre-laid optical fibers. The concrete is usually poured in thin layers and compacted, often using a vibrating table, to remove air bubbles (voids) and ensure uniformity.

Demoulding and Curing: The mould is removed after approximately 24 hours. The cast specimen is then subjected to a curing process (e.g., submerged in water) for a specified period, typically 7, 14, or 28 days, to develop its strength.
Finishing: After curing, any excess fibers protruding from the surfaces are cut and the faces of the block/panel are polished to enhance transparency and achieve the desired aesthetic appearance.

III. CONCLUSION

Research has been shown that transparent concrete can maintain strength comparable to conventional concrete, making it suitable for a variety of applications including load bearing walls, floors, and panels. Transparent concrete reduces the need for artificial lighting by transmitting natural light, which can lower electricity consumption and costs. It can be used in a wide range of applications, such as decorative elements, partitions, paving, and even in furniture. It offers unique design possibilities for both facades and interiors by creating a stunning interplay of light, shadow and colour.

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