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A Study on Transparent Concrete : A Novel Material To Explore Construction Sector

Sakshi. P. Kulkarni[1], Prof. Hemant. D. Wagh[2] , Dr. Dilip. M. Patel[3] , Prof. S. M. Baviskar[4]

P.G. Student, Department of Civil Engineering, S.J.R.I.T. Dondaicha, Maharashtra, India[1]

H.O.D, Department of Civil Engineering, S.J.R.I.T. Dondaicha, Maharashtra, India[2]

Principal, S.J.R.I.T Dondaicha, Maharashtra, India[3]

Assistant Professor, Department of Civil Engineering, S.J.R.I.T. Dondaicha, Maharashtra, India[4]

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.

Today we are living in a world where energy expenditure and environmental problems have escalated to global scale. In today's developed world our built environment takes energy; energy to make the materials that go into the buildings, energy to construct them (Embodied energy) and energy to heat, cool & light them (Operating energy). Our project of casting translucent concrete aims at reducing this operating energy by exploiting vast amount of potential energy in the form of sunlight. Another additional feature is its pleasing aesthetics that can change the image of the concrete which is generally perceived as dull, pale, opaque grey material. (Soumyajit Paul and Avik Dutta)

Transparent concrete is one of the different techniques, and it is also different from normal conventional Concrete. It is also known as LiTraCon. Transparent Concrete is originally found in the year 2001. (Gomasa Ramesh)

In the last decade, transparent model materials have been suggested to monitor and analyze internal phenomena in detail during the processing of fresh concrete. A model cement paste and a model concrete should meet the relevant rheological features of real fresh cement and fresh concrete, e.g., their non-Newtonian flow behaviour, as accurately as possible. . In the study at hand these model systems should also allow for optical access to the near wall and bulk flow regions without any distortion. (G. K. Auernhammer et.al)

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To improve indoor air quality and achieve human comfort smart materials will help in achieving these objectives, provide an opportunity for new wealth creating products and could have an important role in sustainable architecture and interior design. (Dr. Shaimaa Samir Fahmy Mohamed)

The main aim of transparent concrete is to produce transparency and its objective of application connect it to green technology and artistic finish. It is the "combination of optical fibers and fine concrete". (Riya. A. Gite and Shilpa Kewat)

The transparent concrete is the one of the materials used to introduce the natural light inside the building or to reduce the power consumption and also to increase the indoor brightness in civil structures.

It is the concrete based building material which is having light transmitting properties. (Rajesh R Naik and Dr. K B Prakash)

The principle is based on "Nano-Optics", optical fibers pass as much light when tiny slits are placed directly on top of each other as when they are staggered. The principal can carry because optical fibers in the concrete act like the slits and carry the light across throughout the concrete. (Aniket Yadav et.al)

One approach is to exchange the traditional ingredients with transparent or translucent alternatives. Aggregates can be replaced with transparent alternatives, and the bonding material itself may be able to transmit light by incorporating clear resins in the mix. Another approach is the "combination of optical fibers and fine concrete". (Akshaya B Kamdi)

Conventional concrete is formed with the mixture of cement, fine aggregate, coarse aggregate and water which is unable to transmit lights. Transparent concrete is formed with cement, fine aggregate, coarse aggregate and water with optical fibers reinforced in concrete from one face to another which guide the light passing through it following the reflection property. (Ankita B. Meshram and Prof. Dilip L. Budhlani)

The creator and originator of transparent concrete is Aron Losoncz, a Hungarian architect, graduated from Royal College of Fine Arts in Stockholm. While studying, he experimented with two fundamentally different materials: concrete and glass. He tried to obtain a material that would combine the characteristics of the two components: glass transparency and the load bearing capacity and structural properties of concrete. In this way, transparent concrete was created. (Monika Zielińska and Albert Ciesielski)

A smart transparent concrete - novel construction material was manufactured with plastic optical fiber (POF) and Fiber Bragg Grating (FBG) by drilling through the cement and mortar in order to utilize the light guiding ability of POF and the sensing properties of FBG, respectively. The main purpose was to use sunlight as a light source in order to reduce the power consumption of illumination. Meanwhile, the steady sensing offered by FBG allows detection of potential internal deformation of the concrete.

Due to Optical fibres outstanding light guiding and sensing advantages, such as anti-electromagnetic interference capability, small dimensions, distributed measurement and anti-corrosion characteristics, optical fibers have been widely adopted in the communication and sensing fields. The smart transparent concrete not only reduced the power consumption of illumination but also hade detection of potential internal deformation of the concrete.

II. LITERATURE REVIEW

[1] Genda Chen: Development and Research of Smart Transparent Concrete Using Plastic Optical Fiber. The paper presents the creation of an innovative smart transparent concrete incorporating plastic optical fibers (POF), highlighting its unique transparency and sensing capabilities. In this research, the development of a novel smart transparent concrete using plastic optical fiber is discussed along with its transparent and smart sensing properties.

[2] V. Scinduja: An Experimental Investigation of Light-Transmitting Concrete. This study explores how layering optical fibers within concrete not only enhances its structural strength but also allows for creative decorative patterns. He arranged the optical fibers in different layers that increases the load carrying capacity of concrete and also the pattern can be created to make the concrete decorative.

[3] Bhavin K. Kashiyani: Transparent Concrete: A Novel Architectural Material for Construction Combines the strengths of concrete and optical fibers to create aesthetically appealing transparent concrete for innovative building designs. He integrate the merits of concrete and optical fiber for developing transparent concrete and use for good aesthetical view of the building.

[4] P. Siddartha Reddy: Light Transmitting Concrete Using Plastic Optical Fibers. Introduces LiTraCon as an eco-friendly, energy-efficient material ideal for enclosed or poorly ventilated environments. It is energy saving and green technology, it has great scope in closed and non-ventilated spaces.

[5] M.N.V. Padma Bhushan: He had Modeling Translucent Concrete Blocks with Optical Fibers. Also explores the design and benefits of transparent concrete blocks, highlighting their role in advancing smart construction

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techniques. He had done the paper deals with the modeling of transparent concrete blocks, their usage and advantages it brings in the field of smart construction.

[6] Joao Manuel: In 2013 he studied the lightweight concrete have important features that make its use that including weight reduction, improved physical properties and their durability. In the various types of lightweight concrete the type of lightweight aggregate used varies, like the expanded granulated cork, expanded clay, pumice stone, polystyrene foam or EPS. A translucent lightweight concrete as construction material, decoration material and material for furniture comprising and they achieved using cork, fiber optics and special mortar cement. In 2016 he replaced fine aggregate by waste toughen glass as 5%, 15%, 25% and 35% by weight for M30 mix design. As glass is a major component of solid waste stream, it is cheaper and can be found in many forms including container glass, glass door, vertical window, furniture, bathroom, etc. the concrete specimen was tested for compressive strength and the results obtained were compared with those of normal concrete. The partial replacement of fine sand by waste toughen glass gives best result at 25% replacement of fine sand by waste toughen glass. The strength of glass concrete has increased by 7% at 25% partially replacement of fine sand by waste toughen glass as compare to conventional concrete. It has observed that the crack width goes on increasing over the 25% replacement of the waste toughen glass in concrete. It also reduces the total cost of the project.

[7] Soumyajit Paul and Avik Dutta: In 2019 Soumyajit Paul and Avik Dutta has, provided the information about transparent concrete, good light guiding property and the ratio of optical fiber volume to concrete.

[8] Gomasa Ramesh: In 2021 he gives main importance of transparent concrete to improve the architectural view and also improves the appearance of the structure

[9] G. K. Auernhammer: In 2020 he gives information about transparent model concrete with tunable rheological and optical properties is proposed. Rheological tunability is a key feature in mimizing the behaviour of real concrete under processing conditions such as pumping and mixing.

[10] Riya. A. Gite and Shilpa Kewate: In 2017 they concluding the strength of transparent concrete by an experimental study.

[11] Rajesh R Naik and Dr. K B Prakash: In 2020 they concluded that the strength parameter of transparent concrete reaches a peak value at 1.5% addition of GI fibres.

[12] Aniket Yadav: In 2018 he compiles the finding and results of the previous research and studies on transparent concrete, which can be used as a base to carry out further studies and development in the field of transparent concrete.

[13] Akshaya B Kamdi: In 2021 he concluded that Translucent concrete is one of the most interesting new takes on the historically stiff and uninspiring building material.

[14] Ankita B. Meshram and Prof. Dilip L. Budhlani: In 2020 they concluded that an innovative material called transparent concrete can be established by introducing optical fiber in concrete mix. The Translucent concreter has good lightening property and gives greatest architectural appearance to structures.

[15] Monika Zielińska and Albert Ciesielski: In 2017 they introduce analysis of Transparent Concrete as an Innovative Material Used in Civil Engineering.

[16] Juan Shen and Zhi Zhou: In 2020 they concluded that the transparent concrete has good light guiding property and the ratio of optical fibre volume to concrete is proportion to transmission.

III. AIM AND OBJECTIVES

[1] Preparation and experimental study of transparent concrete.
[2] Evaluation of its physical appearance and its structural characteristics, such as compressive strength.
[3] Compare the results of transparent concrete and normal concrete.
[4] Cost comparison between transparent concrete to normal concrete. To identify the major factors affecting the cost and performance of geopolymer concrete.
[5] To identify the major factors affecting the cost and performance of transparent concrete.
[6] To study development in performance of concrete in light transmission by using optical fibre and improve performance of structure to derive natural light.
[7] To make concrete partially transparent by using optical fibres in it to impart good appearance to structure.

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[8] To study the strength characteristics of transparent concrete.
[9] To compare strength characteristics of transparent concrete and Conventional concrete.

IV. MATERIALS AND EXPERIMENTAL METHODOLOGY

Concrete: It is a material from construction field, which is one of the most important civil engineering materials with the advantages of rich raw materials, low cost and simple production process. It consists essentially of a binding medium, such as a mixture of Portland cement and water, within which are embedded particles or fragments of aggregate, usually a combination of fine and coarse aggregate.

Optical Fiber: It is a material from sensing field, has a good light guiding property which can be arranged to transmit the sun light or the artificial light according to pre-design road without light-heat, light-electrical or photochemical process, and photo elastic effect. Fiber optics are long, thin strands of very pure glass, about the size of a human hair. They are arranged in bundles called optical cables.
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.

Steps for experiment :

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.

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SPECIMEN PREPARATION AND TESTING



- **Test Details:**
  - **Cube Dimensions: 150 mm × 150 mm × 150 mm**
  - **Concrete Grade: M20 (cement to sand ratio of 1:1.5)**
  - **Fiber Content: 4% of the total material volume**
  - **Maximum Load Applied: 465 kN**

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S.R. NO.	Age of Curing (days)	Dimension of Cubes (mm x mm xmm)	Area of cube (mm^2)	Load Failure (kN)	Compressive Strength (N/mm^2)
1	7	150x150x150	22500	325	14.44
2	14	150x150x150	22500	365	16.22
3	28	150x150x150	22500	450	20

Compressive strength test result for normal cube

S.R. NO.	Age of Curing (days)	Dimension of Cubes (mm x mm x mm)	Area of cube (mm^2)	Load Failure (kN)	Compressive Strength (N/mm^2)
1	7	150x150x150	22500	330	14.66
2	14	150x150x150	22500	375	16.66
3	28	150x150x150	22500	465	20.66

Compressive strength test result for transparent concrete cube

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.

However, it is expensive and still more issues to be resolve. The drawback of transparent concrete is its high manufacturing cost.

COST ANALYSIS: STANDARD CONCRETE VS. TRANSPARENT CONCRETE

Standard Concrete (M20 Grade, 10 Cubes)

- Cement volume: 0.0113 m^3
- Cement cost: ₹100
- Sand volume: 0.017 m^3
- Sand cost: ₹16
- Coarse aggregate volume: 0.034 m^3
- Coarse aggregate cost: ₹31
- **Total cost: ₹147**

Transparent Concrete (M20 Grade, 10 Cubes)

- Cement volume: 0.0256 m^3
- Cement cost: ₹222
- Sand volume: 0.0384 m^3
- Sand cost: ₹34
- Fiber volume: 0.0016 m^3
- Fiber cost (approximate): ₹100
- **Total cost: ₹356**

I. LIMITATIONS AND FUTURE WORK

Limitations

The present study is limited to the experimental investigation of transparent concrete prepared using optical fibres, fine aggregates and cement. The compressive strength was evaluated at 7, 14, and 28 days and compared with the conventional M20 grade concrete.

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The 28-day compressive strength of transparent concrete was 20.66 N/mm², which was slightly higher than the 20 N/mm² strength of M20 concrete.
The study primarily focused on compressive strength and material cost; other properties, such as tensile strength, flexural strength, durability, and long-term performance, were not investigated.
The higher cost of optical fibres increases its manufacturing cost. The main disadvantage is this concrete is very costly because of the optical fibres.
Casting of transparent concrete block is difficult for the labour so special skilled person is required.
Deterioration of the transparent concrete is not yet known.

Future Work

- Study on replacing optical fiber with acrylic rods, waste glass, etc. can be carried out.
- Replacing with different types of cement like white cement and also with various types of recyclable materials which are suitable and strength and durability tests can be done and results can be found out accordingly.
- By introducing various percentages of optical fib in design procedure, studies can be carried on.
- Studies can be carried out on high strength concrete made with recycled aggregates

REFERENCES

[1]. IS 12269:2013 Specification for 53 grade ordinary Portland cement. Bureau of Indian Standards, New Delhi.
[2]. IS: 383-1970. Specification for coarse and fine aggregates from natural sources for concrete. Bureau of Indian standards, New Delhi.
[3]. IS: 2386-1963 Part I to VIII. Indian standard Methods of test for aggregate for concrete. Bureau of Indian standards, New Delhi.
[4]. Shetty, M.S "Concrete technology" Chand S and Co.Ltd, India (2009).T. Bhagyasri et al "Role of Glass Powder in Mechanical strength of concrete", IRF International Conference. March.
[5]. Dr. M. Vijaya Sekhar Reddy et al "Incorporation of Waste Glass Powder as Partial Replacement of Fine Aggregates in Cement Concrete", IJSER, Volume 5, Issue 12, December 2015.M.
[6]. Soumyajit Paul and Avik Dutta, 2019, "TRANSLUCENT CONCRETE", International Journal of Scientific and Research Publications, Volume 3.
[7]. Gomasa Ramesh 2021, "Transparent Concrete: A Review", Indian Journal of Structure Engineering (IJSE), Volume
[8]. G. K. Auernhammer, Shirin Fataeic, Martin A. Hausteind, Himanshu P. Patel a, Rudiger Schwarze d, Egor Secrieru c, Viktor Mechtcherine, 2020, "Transparent model concrete with tunable rheology for investigating flow and particle-migration during transport in pipes".
[9]. Dr. Shaimaa Samir Fahmy Mohamed, 2018, "Application of Transparent concrete in the interior design of smart houses", PP: 89-103.
[10]. Riya. A. Gite and Shilpa Kewate, 2017, "Transparent Concrete; an Experimental Study", IJSTE - International Journal of Science Technology and Engineering, Volume 4.
[11]. Rajesh R Naik and Dr. K B Prakash, 2020, "An experimental investigation of fiber reinforced transparent concrete", International Research Journal of Engineering and Technology (IRJET), Volume: 03, PP: 1038-1044.
[12]. Aniket Yadav, Shubham Shekhar, Abhishek Anand, Akashdeep Badal, Dr. Bushra Zaman, 2018, "An Investigating Study on a new Innovative Material: Transparent Concrete", International Journal of Engineering Research and Advanced Development, Volumn:4, PP: 64-72.
[13]. Akshaya B Kamdi, 2021, "Transparent concrete as a green material for building", Volume: 2, PP: 172-175.
[14]. Ankita B. Meshram and Prof. Dilip L. Budhlani, 2020, "Design and Experimental Study on Transparent Concrete", International Research Journal of Engineering and Technology (IRJET), Volume: 07, PP: 1875- 1877.
[15]. Zhi Zhou, Ge Ou, Ying Hang, Genda Chen, Jinping Ou, 2019, "Research and Development of Plastic Optical Fiber Based Smart Transparent Concrete".