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Aesthetic Improvement by InnovativeTranslucent Concrete

Prof. I.M. Jain[1], Ajinkya Vispute[2], Atul Shirsath[3], Devang Sood[4]
[1, 2, 3, 4]*Civil Engineering Department, Sinhgad Institute of Technology and Science, Savitribai Phule Pune University*

Abstract: ***Concrete has been used since Roman times for the development of infrastructure and housing, but its basic components have remained the same. Three ingredients make up the dry mix: coarse aggregate, consisting of larger pieces of material like stones or gravel; fine aggregate, made up of smaller particles such as sand; and cement, a very fine powder material that binds the mix together when water is added. Just a few decades ago concrete was often misunderstood, disliked and captured by its image fixed due to the rapid urbanization of the 1960s. But since that time, concrete has made considerable progress, not only in technical terms, but also in aesthetic terms. It is no longer the heavy, cold and grey material of the past; it has become beautiful and lively. By research and innovation, newly developed concrete has been created which is more resistant, lighter, white or coloured, etc. Concrete has learned to adapt to almost all new challenges that appeared. In 2001, the concept of translucent concrete was first put forward by Hungarian architect Aron Losonzi at the Technical University of Budapest, and the first translucent concrete block was successfully produced by mixing large amount of glass fibre into concrete in 2003, named as LiTraCon. The translucent concrete mainly focuses on transparency and its objective of application pertains to green technology and artistic finish. It is the "combination of optical fibres and fine concrete". At present, green structures focus greatly on saving energy with indoor thermal systems. Therefore, it is imperative to develop a new functional material to satisfy the structure in terms of safety monitoring (such as damage detection, fire warning), environmental protection and energy saving and artistic modelling. Due to globalization and construction of high-rise building, the space between buildings is reduced; this causes to increasing the use of non- renewable energy sources, so therefore there is a need of smart construction technique like green building and indoor thermal system. Translucent concrete (Transparent concrete) is new technique different from normal concrete.***

Keywords: Translucent Concrete, Optical Fibres, Non-Renewable Sources, Artistic Modelling, Energy Saving.

I. INTRODUCTION

Translucent concrete is a new material with various applications in the construction field, architecture, decoration and even furniture. As can be imagined concrete with the characteristics of being translucent will permit a better interaction between the construction and its environment, thereby creating ambiences that are better and more naturally lit at the same time as significantly reducing the expenses of laying and maintenance of the concrete. Optical fibres are arranged side by side on a concrete base leaving the light to pass from one side to other side. Due to small thickness of fibre that the fibre are combined to transmit light. Compared with a traditional electric lighting system illuminating the indoors with daylight also creates a more appealing and healthy environment for building occupants. It was a combination of optical fibre and fine concrete combined in such a way thatthe material was both internally and externally homogeneous. It was manufactured in blocks and used primarily for decoration. It can be used for both the interior walls and exterior walls, illuminated pavements or even in arts or design objects.

Translucent concrete allows lighter and less weight compared to normal concrete. The use of sunlight source of light instead of using electrical energy is main purpose of translucent concrete, so as to reduce the load on non- renewable sources and result it into the energy saving. Optical fibre are a sensing or transmission element, so decrease the use of artificial light, the normal concrete is replaced by translucent concrete, which has natural lighting and art design.

II. LITERATURE REVIEW

1) Study of Translucent Glass Concrete (2016) *Sisira Sugunan et al,* in this paper, experimental studies were conducted in orderto analyze the possibilities for recycling waste glass as fine aggregate for concrete. This paper focuses on making a solid building block by replacing fine aggregate with crushed glass waste and also to introduce translucency for aesthetic effect.

2) An Experimental Study On Light Transmitting Concrete (2014) P.M. Shanmugavadivu et al Light transmitting concrete is one of the fibre reinforced concretes which is used for aesthetic application by incorporating the optical fibres in concrete. Optical fibres are one which helps for transmission of light through fibre. The end-lite type of fibre is used to increase the aesthetic appearance of the concrete. The concept of light transmitting concrete is like a transparent concrete

3) Optical Fibres in the Modelling of Translucent Concrete Blocks (2013) M. N. V. Padma Bhushan et al, this paper deals with the modelling of such translucent or transparent concrete blocks and their usage and also the advantages it brings in the field of smart construction.

4) Translucent Concrete (2013) Soumyajit Paul et al, the concrete currently used in the construction industry generally consists of at least cement, water and aggregates (fine or coarse). As is well known, traditional concrete has a greyish colour, and its high density prevents the passage of light through it, which means that it is also impossible to distinguish bodies, colours and shapes through it.

5) Study of behaviour of light transmitting concrete using optical fibre (2015) Satish Kumar V et al the fibre. In this paper, the main purpose is to use sunlight as a light source in order to reduce the power consumption, because the brightness of indoor environment is entirely created by artificial lighting which has consuming a large amount of power supply.

6) Light Transmitting Concrete- A New Innovation (2015) Patil Gaurao S. et al, - In this paper, based on the excellent properties of light guiding and elasto-optic effect of optical fibre, a novel smart transparent concrete is researched by arranging the optical fibres into the concrete.

7) Translucent Concrete (2017) Omkar Kadam, et al -This article deals with the usage of translucent concrete and also the advantages it brings in the field of smart construction, that it can reduce the power consumption of illumination and use the optical fibre can be made to sense the stress of structures and this concrete as an architectural purpose for good aesthetical view of the building.

8) Experimental Analysis of Translucent Concrete by using Optical Fibers (2016) Nikhil k, et al The principal objective of this project is to design translucent concrete blocks withthe use of glass optical fibers, and then analyse their various properties and characteristics. All tests further performed on our concrete samples and on the optical fibers as such were done to ascertain the improvements of the casted blocks over normal concrete blocks of the same size and with the same design ratios, and to ascertain the practical utility of using translucent concrete as a building material for green building development.

9) Transparent Concrete (2017) Rasvir Singh,et al-In this paper, to integrate the merits of concrete and optical fiber, for developing transparent concrete by arranging the high numerical aperture Plastic Optical fibers (POF) or big diameter glass optical fiber into concrete. The main purpose is to use sunlight as a light source to reduce the power consumption of illumination and to use the optical fiber to sense the stress of structures and also use this concrete as an architectural purpose for good aesthetical view of the building.

10) Translucent Concrete (2017) Sasidharan. J,et al - This study, particularly aims at using concrete as also an architectural element rather structural and its feasibility of production without use of complicated equipment and methodology. The skill of building construction arouses for human need for a shelter. Since then, the skill has been susceptible to various changes due to outer environment and the man's need.

11) Translucent Concrete: A Research Paper (2022) Aditya Katore et al, In this research paper we are casting a block and slab of size 18×7×7 cm3 &100×7×300cm3 respectively by using cement, sand, aggregate, with optical fiber & glass. In this research paper we should try to reduce its cost by using glass rod with the small composition of optical fiber.

12) Transparent concrete by using optical fibre 2022 Chandrasekaran Palanisamy et al, Transparent concrete is a modern type of concrete that is gaining popularity in the construction industry. The advancement of material technology has resulted in the production of modern materials as well as environmental and energy conservation.

13) Translucent Concrete by Plastics Fibre Optics as A Sustainable Material That Benefit to Residential Building (2019) Ong Wei Huong et al, Concrete regarded as a fundamental construction material that currently applied in construction development since Roman times whereby the basic composition of concrete consists of at least cement, aggregates (fine or course) and water. As usual, the normal concrete has a greyish colour and high-density characteristic which basically prevents the light from transmitting through the concrete itself. Currently, a newly developed translucent concrete has been fabricated with their transparency that may allow permission of light.

14) Study On Translucent Concrete By Using Optical Fiber (2021) Shabnajasil K et al - Translucent concrete is a composite material consisting of optical fibers, fine aggregate, ordinary Portland cement and water.

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It is different from conventional concrete as it contains no coarse aggregates. To evaluate the effectiveness of the smart translucent concrete, the present study aims at producing the concrete specimens by using optical fibers and comparing it with the normal cement concrete.

III. OBJECTIVES

1) To study strength characteristics of Translucent Concrete.
2) To compare strength characteristics of Translucent Concrete & Normal Concrete.
3) To check the light transmittance of the Translucent Concrete.
4) To reduce the load on non-renewable source and result it into the energy saving.

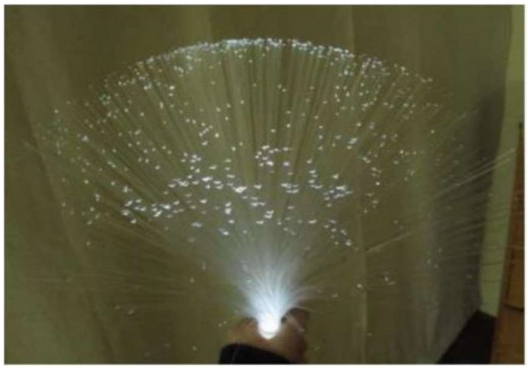

Fig No. 1

IV. SCOPE OF THE PROJECT WORK

1) Translucent concrete is also a great insulating material that protects against outdoor extreme temperatures while also lettingin daylight.
2) This makes it an excellent compromise for buildings in harsh climates, where it can shut out heat or cold without shutting the building off from daylight.
3) It can be used to illuminate underground buildings and structures, such as subway stations.
4) The possibilities for translucent concrete are innumerable; the more it is used, the newer uses will be discovered.
5) In the next few years, as engineers further explore this exciting new material, it is sure to be employed in a variety of interesting ways that will change the opacity of architecture as we know it.

V. APPLICATION OF TRANSLUCENT CONCRETE

1) Transparent concrete blocks suitable for floors, pavements and load-bearing walls.
2) Facades, interior wall cladding and dividing walls based on thin panels.
3) Partitions wall and it can be used where the sunlight does not reach properly.
4) In furniture for the decorative and aesthetic purpose.
5) Light fixtures.
6) Light sidewalks at night.

VI. MATERIAL DATA AND SPECIFICATION

1) Crushed Sand: Coarse aggregate having a size of 5mm and 10mm were used. The coarse aggregate is clean, hard, non-porous, free from lumps of clay and vegetable matter. Water absorption of aggregate is not more than 10 % of its weight after 24 hours immersion in water. Angular and roughly cubicle particles are ideal. River gravels make the best coarse aggregate. Aggregate is chemically inert material. Brick aggregate is not used in RCC work.
2) Micro Silica : Is a high performance pozzolan with unique chemical and physical properties that enable cement-based systems and mix designs to achieve higher levels of performance and durability. Silica Fume allows engineers and specifiers to meet and exceed design and performance criteria. Silica Fume will greatly increase concrete strength and reduce permeability which in turn contributes to increased durability for chemical resistance, chloride attack, sulphate attack, and abrasion resistance. Increased cohesion using Silica Fume aids in Self Consolidating Concrete and Shotcrete applications.

3) Fly Ash: Amount of fly ash required in referred from IS 3812 (Part 1) : 2013 A cement is a binder, a chemical substance used for construction that sets, hardens, and adheres to other materials to bind them together. Cement is seldom used on its own, but rather to bind sand and gravel (aggregate) together. Cement mixed with fine aggregate produces mortar for masonry or with sand and gravel, produces concrete. Concrete is the most widely used material in existence and is behind only water as the planet's most-consumed resource

4) Retarder: Retarding admixtures are used in concrete practice to delay the setting times of cement paste, mortar and concrete. In hot weather concreting, delays in transport and handling between mixing and placing may result in early setting and loss of workability and in such instances incorporation of retarders becomes necessary. Retarders may be used in steam curing of concrete, to offset the long-term lower strengths developed by the silicate phase and in the construction of large structural units, dams and the fabrication of exposed aggregate panels. Another important application of retarders is to maintain returned concrete from ready-mixed trucks in a workable condition overnight by completely freezing the hydration. Special types of retarders can control the slump loss in superplasticizer concrete.

Fig No. 2

Fig No. 3

5) Cement: The type of cement used in this work is 53-grade OPC. The specific gravity of the cement uses is 3.15 and its fineness modulus of 2% which is less than the maximum value of 7%. As per IS 8112: 2013

6) Polishing process: We did Dimond cut polish on mould, which helps remove cement mortar on block and shining on it.

7) Result:


Fig No. 4

Fig No. 5

VII. COMPRESSIVE TEST

	7 Days	14 Days	28 Days
First cube	19.84 KN/m^2	31.60 KN/m^2	33.59 KN/m^2
Second Cube	20.21 KN/m^2	31.80 KN/m^2	33.90 KN/m^2
Third Cube	20.89 KN/m^2	32.76 KN/m^2	34.00 KN/m^2
Average	20.31 KN/m^2	32.05 KN/m^2	33.83 KN/m^2

VIII. PROBLEM FACE WHILE PREPARATION

1) Difficult to separated optical fibre from wire.
2) Rarely available in market.
3) Optical fibre not available in colour
4) Get damage while separating fibre.
5) While removing fibre gloves are required because, most of the time fibre micro piecesget stacked in fingers and hand.
6) Cutting optical fibre is difficult, it required sharp edges cutter.
7) While putting optical fibre in several holes, it should be matched by both sides.
8) Both sides extra optical fibre required, it get spoiled due to vibration.
9) While casting, block should be tightened from all the side with steel wire or hinges.
10) Properly oil the block before casting.
11) If there is any damage in a block fill it by POP (Plaster of Paris) or cement mortar forfinishing.

IX. IMPLEMENTATION IN FUTURE

1) Colour a wall including fibre, check transmitting property of fibre
2) Used optical fibre 2mm or more size.
3) Used different colour of fibre

X. TEST RESULTS AND DISCUSSION

1) Compressive Strength Results - The results of POF 1 mm diameter for various volume fraction. The obtained results indicated that the compressive strength at 7 days age decreases as fibre content increases, Where the decrease was about (20.21, 19.84and 20.04 %) for (2, 3,4%) fibre volume fraction content respectively as compared with reference sample without POF.
2) While at 14 days age the compressive strength improved due to the hydration of cement development of interfacial transition zone between the matrix and the POF. So that the results show the compressive strength decreased by about (32.76,31.60 and 32.18 %) for (2, 3and 4%) fibre volume fraction content respectively as compared with reference sample without POF.
3) The same trend is observed at 24 days age this main that inclusion of POF in the matrix did not affect the compressive strength significantly. The compressive strength of POF 1 mm diameter is decrease when fibre content increased for all ages, and the decrease in compressive strength at 28 days age is (34.00, 33.59 and 33.60 %) for(2,3and4%) fibre volume fraction content respectively as compared with reference sample without POF.

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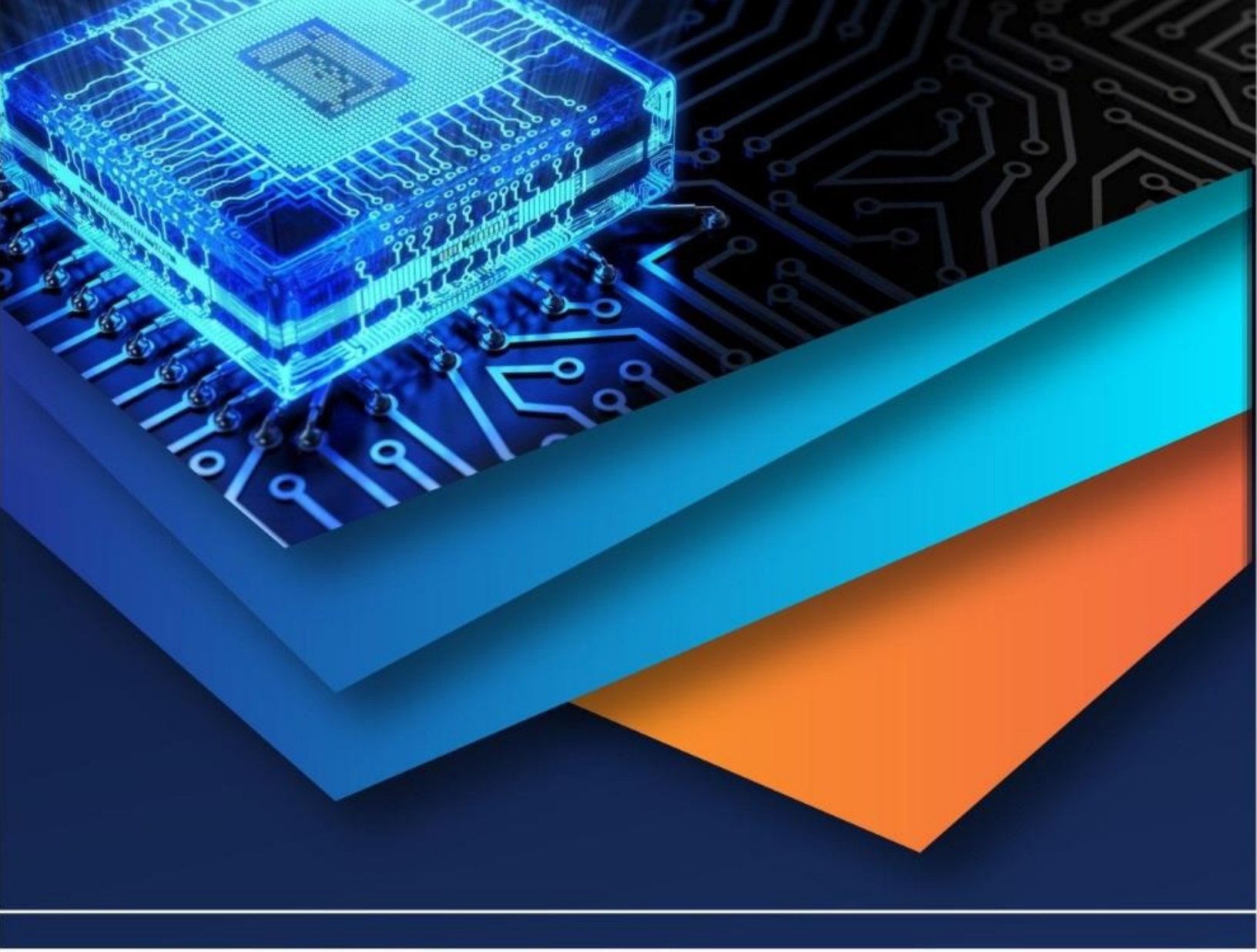

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