

Experimental Investigation on Transparent Concrete using Optical Fiber and Crumbed Rubber-A Review

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Abstract: *Transparent concrete as the smart and green building material with increased strength good aesthetic appearance and also having the light transmitting property. Transparent concrete is the new type of concrete introduced in modern era which carries special property of light transmitting due to presence of glass powder & is also known as translucent concrete or light transmitting concrete and also by adding crumbed rubber It is lighter than conventional concrete having special features such as low density and thermal conductivity with main advantage of reduction in dead weight. Transmissive and light weight properties due to embedded light optical elements usually Optical fibers and glass powder and crumbed rubber. Main aim of the study is to design light weight and translucent concrete blocks with the use of glass powder and crumbed rubber with sand & cement. The cement replaced with glass powder and fine sand replaced with crumbed rubber and then analyse their various physical & engineering properties with respect to conventional concrete. The specimen casted will contain 90% of concrete and 5% of plastic optical fibers. And 5% crumbed rubber The concrete considered is cement mortar which contain fine aggregate and cement. The fibers are disturbed in shortest direction to increase the transparency of concrete use of this concrete is an architectural purpose for good aesthetical view of the building.*

Keywords: Glass powder Crumbed rubber , optical fibers, Workability, Compressive strength, Flexural strength

I. INTRODUCTION

Translucent lightweight Concrete is a new material with various applications in the construction field, architecture, decoration and even in furniture industry. In today's time where whole of the research is concentrated towards non utilization of natural resources as much as possible and to reduce its consumption which are decreasing with time, Lightweight LiTraCon ("Lightweight light transmitting concrete") is a lightweight translucent concrete building material made of fine concrete embedded with up to 5% by weight of concrete mix which are impregnated inside the concrete cubes so that light can be transmitted from the outside in or inside out of the building. Due to great economic growth, urbanization, population growth, space utilization worldwide, there is drastic change in concrete technology. Most of the big buildings are built close to each other all in the same areas like sky scrapers There arises one of biggest problem in deriving natural light in building due obstruction of nearby structures. When buildings are stacks closed to each other, there is not much natural sunlight passing through it.

This innovative concrete is made transparent by reinforcing the optical fibers and crumbed rubber in it. This is because of optical fibers can transmit sunlight without any light, heat or any other photochemical reaction. In this optical plastic fiber can transmit the light from one end of the fiber to another end.

II. LITERATURE REVIEW

Visakh. V. A -Transparent concrete is a concrete based building material with light-Transmissive properties due to embedded light optical elements usually Optical fibers and glass powder. The Light is conducted through the stone from one end to the other. Therefore the fibers have to go through the whole object. Transparent concrete is

also known as the translucent concrete and light transmitting concrete because of its properties. It is used in fine architecture as a facade material and for cladding of interior walls etc. In this project the optical fiber size will vary between $2\mu\text{m}$ and 2mm . In order to increase the transparency of concrete the same amount of cement is replaced by fine glass powder. The glass powder has binding capacity as cement has. The specimen casted will contain 95% of concrete and 5% of plastic optical fibers. The concrete considered is cement mortar which contains fine aggregate and cement. The fibers are disturbed in shortest direction to increase the transparency of concrete. The main purpose of this project is to make a transparent concrete by using plastic optical fiber and glass powder. This work is done 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 aesthetic view of the building.

2) Mr. M. Sudharsanan - In this paper represents transparent concrete as the smart and green building material with increased strength, good aesthetic appearance and also having the light transmitting property. Light Transmitting concrete, also known as translucent concrete. It is the brightest building material development in recent years. It is one of the newest, most functional and revolutionary element in green construction material. In this paper the manufacturing, uses and future scope of transparent concrete is widely given. However, this innovative new material, while still partially in the development stages, is beginning to be used in a variety of applications in architecture, and promises vast opportunities in the future. The function of this invention is to change the traditional image of concrete and add a modern architectural touch. While its main purpose is to use sunlight as a source of light in order to reduce lighting energy consumption, LTC can be used for a diverse range of applications, including floors, pavements, load-bearing walls, furniture, facades, interior wall cladding, dividing walls, and partition walls. There are two basic materials that are used to produce LTC: concrete and light-transmitting material. Fine concrete consists of cement, fine aggregate, small chips and water, while plastic optical fiber is added to create LTC. In LTC, the optical fiber occupies 1% and 2% of the concrete's volume. The distance between the rows of fibers is 5 mm.

3) Shreyas.K. - Transparent concrete is the new type of concrete introduced in modern era which carries special property of light transmitting due to presence of glass rods & is also known as translucent concrete or light transmitting concrete. It is lighter than conventional concrete having special features such as low density and thermal conductivity with main advantage of reduction in dead weight, faster building rate in construction, lower haulage & handling cost. Light is transmitted from one surface of the brick wall to the other due to glass rods along the overall width of the wall which allows light to pass through. An optical glass fibre (or optical fibre) is a flexible, transparent fibre made of glass (silica) or plastic, slightly thicker than a human hair & can function as waveguide, or "light pipe" to transmit light between the two ends. Main aim of the study is to design translucent concrete blocks with the use of glass rods with sand & cement then analyse their various physical & engineering properties with respect to conventional concrete blocks by adding glass rods of 1%, 2%, 3%, 4%, 5% at 1.5 cms spacing respectively.

From the study, it can be concluded that there is 5% to 10% increase in initial compressive strength for 7 days & also 10% to 15% increase in initial compressive strength for 28 days to a glass rod mix of up to 3%. Whereas the initial & final characteristic compressive strength gradually decreases with an increase in glass rods in the concrete mix.

4) Abhishek Pratap Singh

In this research paper we are casting a block and slab of size $18 \times 7 \times 7 \text{ cm}^3$ & $100 \times 7 \times 300 \text{ cm}^3$ 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. We observed the light transmission in this block is 90-95% & minor loss of energy can be observed. The strength of slab by using optical fiber is increased 4-5% in the comparison of the normal block & slab.

5) Bhavik K. Daxini

Crumb rubber is a term usually applied to recycled rubber from automotive and truck scrap tyres. During the recycling process steel and fluff is removed leaving Tyre rubber with a granular consistency. Continued processing with a granulator and/or cracker mill, possibly with the aid of cryogenics or mechanical means, reduces the size of the particles further. It is not possible to discharge the rubbers in the environment because they decompose very slowly and cause lots of pollution. So, it is necessary to have a relevant use of these wastages. These waste materials can be

used to improve some mechanical properties of concrete. Addition of rubber to concrete results in the improvements of some mechanical and dynamical properties. Such as more energy absorption, better ductility and better crack resistance. By using the waste tyre (crumb rubber) one can reduce the harmful effect on environment and provide sustainable concrete.

6) M. N. V. Padma Bhushan

Translucent concrete is a concrete based material with light-transmissive properties, obtained due to embedded light optical elements like Optical fibers in it. Light is conducted through the stone from one end to the other. This results into a certain light pattern on the other surface, depending on the fibre structure. Optical fibres transmit light so effectively that there is virtually no loss of light conducted through the fibres. Our 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.

7) Karthika K

Aggregates are inert granular materials that are essential ingredients in a concrete. Aggregates occupy a large volume (i.e.) about 60 to 75% of the concrete, thus the selection of aggregates based on the material, shape, gradation and size is of primary concern before preparing the concrete. However many developing countries like our country face problem in acquiring the aggregates, as they are the most exploited material for the purpose of construction. And this over exploitation has led to scarcity in the availability of aggregates from the natural sources, in many parts of our country. Therefore, in order to meet the demand for aggregates, a modification can be made as partial or complete replacement of these aggregates with any new material, that would potentially induce better and additional properties to the concrete and simultaneously serve as an economical resource. With the Phenomenal growth in the Automobile industry in our country, there are so many waste and used tyres, those are getting discarded every year (i.e.) about 3 crores of used tyres are disposed in our environment. When these tyres are granulated or made into fine powder, they can be effectively used as crumb rubber. This study investigates the use of crumb rubber fragments and crumb rubber fine powder (each material of quantity of about 2%, 4%, 6% and 8%) as a partial replacement of both coarse aggregates and fine aggregates respectively. To evaluate these replacements in the OPC concrete mix, a number of laboratory tests were carried out. The tests those were conducted on the hardened concrete includes the compressive strength test, flexural strength test and Split tensile strength test on the 3rd, 7th and 28th days of curing. Finally, the results of all the above mentioned tests were compared with the conventional concrete to find the potential and the scope of this concrete modified with crumb rubber. This result shows there will be an increase in characteristic of concrete.

8) Yamini Nirmal

Light transmitting concrete is one of the fiber reinforced concretes, which is used for aesthetic application by incorporating the optical fibers in concrete. Optical fibers are one which helps for transmission of light through fibers. In this paper, the work is divided into two phases. In first phase, study of compressive strength and later in second phase study on flexural behaviour were carried out. Light transmitting masonry blocks were prepared of size 200 mm x 100 mm x 100mm, and plastic optical fibers of diameter 0.38 mm were used. Fibers are inserted into the mortar bricks in order to investigate the amount of light transmitting potential and also to determine the strength parameter, i.e., compressive strength. Different percentages of fibers, such as 2% and 4% with different configurations were prepared. From this, the optimum fiber percentage and optimum fiber number along with location is determined and it can be used to observe the flexural behaviour in Prisms of standard size 50 cm x 10 cm x 10 cm and later beams were casted of size 130 cm x 18 cm x 20 cm with mesh, fiber alone, and a combination of both mesh and fiber, and the test results, i.e., Load vs. deflection (Load carrying capacity) were compared with that of regular or conventional concrete beams.

9) Aravind S

Waste tyre and plastic management is a serious global concern. Dumping or disposal of these waste products causes environmental and health issues. This project investigates wide range of physical and mechanical properties of concrete containing recycled tyre and plastic aggregates. Waste tyre and plastics are crushed into fine particles of various sizes and are used to replace fine aggregate in concrete. Fine scrap tyre and plastic aggregates are added as 5%, 10%, 15% increment to replace fine aggregate, this study aims to investigate the optimal use of these wastes as

fine aggregate in concrete composite. Compressive strength, split tensile strength, flexural strength of different mixes of concrete added with these wastes were found.

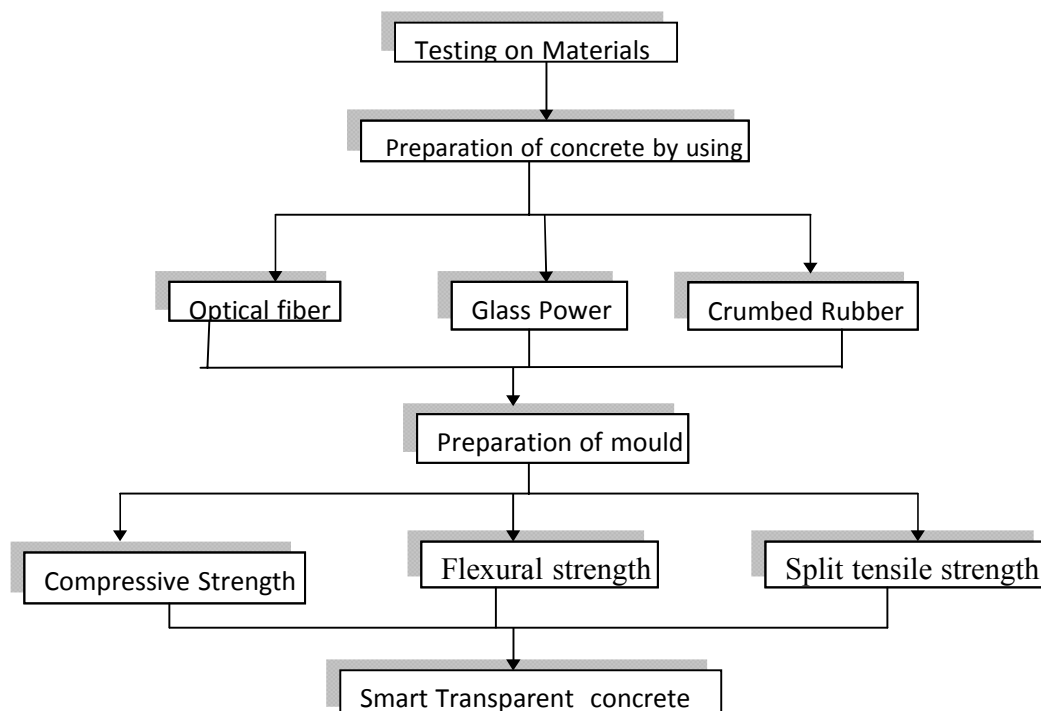
10) Zhi Zhou1

Energy saving and safety evaluation are two key issues for infrastructure. In this paper, the development of a novel smart transparent concrete using plastic optical fiber (POF) and Fiber Bragg Grating (FBG) is discussed, along with its transparent and smart sensing properties. The experimental results show that an optical fiber can be easily combined with concrete and that the POF could provide a steady light transmitting ratio. Moreover, the FBG can be used as a sensing element for strain and temperature. This paper also discusses the mechanical effects of introducing POF into concrete specimens. Because the smart transparent concrete can be regarded as a “green” energy saving construction material and as a smart intrinsic sensor for long-term Structural Health Monitoring (SHM), it is a promising technology for field applications in civil infrastructure.

11) Urmila M Bhanuse

Transparent concrete is a concrete based building material with light-Trans missive properties due to embedded light optical elements usually Optical fibers. Light is conducted through the stone from one end to the other. Therefore the fibers have to go through the whole object. Transparent concrete is also known as the translucent concrete and light transmitting concrete because of its properties. It is used in fine architecture as a facade material and for cladding of interior walls. 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 reducethe 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.

III. METHEDOLOGY



REFERENCES

[1]. Momin, A., Kadiranaikar, R., Jagirdar, V. &Inamdar, A., “Study of Light Transmittance of Concrete Using Optical Fibers and Glass Rods,” Proceedings: International Conference on Advances in Engineering & Technology – 2014.

- [2]. Shanmugavadivu, P., Scinduja, V., Sarathivelan, T. & Shudhesamithronn, C., "An Experimental Study of Light Transmitting Concrete," *IJRET*, vol. 3, no. 11, 2014.
- [3]. Zhou, Z., Ou, G., Hang, Y., Chen, G. & Ou, J., "Research and Development of Plastic Optical Fiber Based Smart Transparent Concrete," *SPIE*, vol. 7293, no. F, 2009)
- [4]. Prasad. Bishetti. Etal, " EXPERIMENTAL STUDY OF TRANSLUCENT CONCRETE ON COMPRESSIVE STRENGTH", International Journal of Technical Research and Applications e- ISSN: 2320 -8163, www.ijtra.com Volume 4, Issue 4 (July-Aug, 2016), PP. 120-122.
- [5]. TRANSLUCENT CONCRETE: A RESEARCH PAPER Abhishek Pratap Singh International Journal of Technical Research and Applications ISSN:2319-8354, www.ijtra.com Volume 07, Issue 01 April 2018.
- [6]. Experimental Study on Transparent Concrete by using Plastic Optical Fiber International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181
- [7]. Abdul Rahman1 Translucent Concrete by using Fibre Optic Strands
- [8]. International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181 IJERTV9IS090438 Vol. 9 Issue 09, September-2020.
- [9]. Anurag H. Shukla, Trushik J. Poriya, Prof. Jigar Zala "An experimental work on light transmitting concrete" Journal of Advance Engineering and Research Development (IAERD) Volume 1, Issue 5, May 2014, e-ISSN: 2348 - 4470, print-ISSN:2348-6406
- [10]. Soumyajit Paul Avik Dutta. "Translucent concrete". international Journal of Scientific and Research Publications, Volume 3, Issue 10, October 2013, ISSN 2250-3153,
- [11]. Dr. Shakir Ahmad Salih, Dr. Hassan Hamodi, Safaa Adnan Mohamad "Evaluation of the mechanical properties of translucent concrete: International journal of engineering trends and technology. January 201
- [12]. IS: 7320-1974 Code of practice for "WORKABILITY OF CONCRETE BY SLUMP TEST".
- [13]. IS:1199-1959 Code of practice for "WORKABILITY OF CONCRETE BY COMPACTION FACTOR TEST".
- [14]. IS:10510-1983 Code of practice for "WORKABILITY TEST BY VEE-BEE CONSISTOMETER".
- [15]. IS: 516-1959 Code of practice for "FLEXURAL STRENGTH TEST".
- [16]. IS 5816-1976 Code of practice for "SPLIT TENSILE STRENGTH TEST".
- [17]. IS: 516-1959 Code of practice for "COMPRESSIVE STRENGTH TEST".
- [18]. MS SHETTY CONCRETE TECHNOLOGY