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Translucent Concrete

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Abstract - In past various type of concrete was developed for construction work which are light in weight, self-compacted, having high strength but after the development of such concrete there are some problems also situated in the buildings that is darkness. In urban area where multi-storey building is situated very near to each other there is darkness in room in day time also. These problems can be solved by translucent concrete which transmit light through it. In day time it transmits sun light to room and at the night it gives good appearance of building. Translucent concrete pass light through it because of presence of optical fibers from outer face to inner face of concrete. Due to light gardening property of translucent concrete it makes energy efficient building. Translucent concrete is that the concrete based artifact with light transmissive properties during which the sunshine transmitted either manually artificially from one end to another end of the concrete. Translucent concrete is additionally referred to as translucent concrete and lightweight transmitting concrete (LiTraCon).

Keywords: recycling, biodegradable, biotic, bio-waste, environment

I. INTRODUCTION

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). Countries with great population have buildings to be ratio higher than that of small population. Those buildings are isolated biosphere only based on manmade lights to maintain people's optical activities. For example, India consumes 20% of total electrical energy for lighting the buildings. At present, green structures are greatly focusing on saving energy with indoor thermal systems. However, in area of illumination field, there is little research offering relevant solution. Research on intrinsic characteristic material which transmit the light from one surface to another surface is used as construction material which transmit the light from one surface to another surface is used as construction material, known as optical fibres. Due to its outstanding light guiding and sensing advantages, such as anti-electromagnetic Interference capability, small dimensions, distributed measurement and anticorrosion characteristics, optical fibres have been widely adopted in the communication and sensing fields. It is considered to be one of the best sensor materials available and has been used widely since the 1990s. Hungarian architect, Aron Losonczi, first introduced the idea of light transmitting concrete in 2001 and then successfully produced the first translucent concrete block in 2003

Light transmitting or translucent concrete is a concrete which transmitting light through it by using optical fiber. It is material which makes green building. Conventional concrete made with the mixture of cement, sand, aggregate and water which is unable to transmit lights, translucent concrete is made with cement, very fine sand and thousand of optical fiber reinforced in concrete from one face to another face which guide the light passing through it. The first translucent concrete was mentioned in 1935 Canadian patent. The concept of translucent concrete was comes in 2001 which is introduced by Hungarian Architect, Aron Losoczi and the first translucent concrete block was successfully made in 2003 by using large amount of glass fiber and it is termed as LiTraCon. Due to development of glass and optical fiber works on translucent concrete will increases. Translucent concrete is not different from conventional concrete it have same material with addition of optical fiber. In many concrete fibers are used to increase the tensile properties of concrete but in translucent concrete optical fibers are not used for such purpose it transmit only lights.

METHODOLOGY

Materials

There are two basic materials used for making translucent concrete, one is from construction field and another from sensing field. First, concrete is one of the most important civil engineering materials with the advantages of rich raw materials, low cost and simple production process and second the optical fibre has good light guiding property which can be arrange to transmit the light and the sun light transmit according to predesign road without light-heat, light-electrical or photochemical process, and photo elastic effect which can be used to study the stress distribution of structures.

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Combining the advantages of the concrete and optical fibre, developing a novel functional material called translucent concrete has an important value in the application of construction and sensing [5].

2.1.1Optical Fibre

An optical fibre is a flexible, translucent fibre made of silica or plastic, slightly thicker than a human hair. It functions as a waveguide or light pipe, to transmit light between the two ends of the fibre. The field of applied science and engineering concerned with the design and application of optical fibres is known as fibre optics. Optical fibres are widely used in fibre-optic communications, which permits transmission over longer distances and at higher bandwidths .Fibres are used for illumination, and are wrapped in bundles so that they may be used to carry images, thus allowing viewing in confined spaces. Specially designed fibres are used for a variety of other applications, including sensors and fibre lasers. Optical fibres typically include a translucent core surrounded by a translucent cladding material with a lower index of refraction as shown in Fig. 2.1.1. Light is kept in the core by total internal reflection. This causes the fibre to act as a waveguide.

Fibres that support many propagation paths or transverse modes are called multi-mode fibres (MMF), while those that only support a single mode are called single-mode fibres (SMF). Multi-mode fibres generally have a wider core diameter, and are used for short-distance communication links and for applications where high power must be transmitted.

Optical fibre is a translucent and flexible material made of silica. This optical fibre helps to transmit light in the cube from one end to other end. The percentage of optical fibre used for the study is 2% by volume.

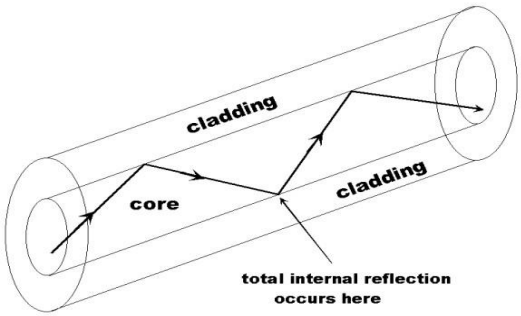

Fig 2.1.1 : Optical Fiber

Optical fibres work as a cylindrical waveguide that transmits light along its axis, by the process of internal reflection. Optical fibre has good light guiding property which can be arrange to transmit the light and the sun light transmit according to pre- design road without light-heat, light-electrical or photochemical process, and photo elastic effect which can be used to study the stress distribution of structures. Combining the advantages of the concrete and optical fibre, developing a novel functional material called translucent concrete has an important value in the application of construction and sensing.

1) 2.1.2Principle of Operation

Translucent concrete or translucent concrete is work Based on “Nano-Optics”. Optical fibres passes as much light when tiny slits are placed directly on top of each other as when they are staggered. Principal can carry because optical fibres in the concrete act like the slits and carry the light across throughout the concrete. The fibre will change the interior appearance of buildings by illuminating them and better appearance. The main purpose of using optical fibre is that it can transmit light. Plastic Optical Fibre (POF) can with stand harsh environment and has a higher ductility and good flexibility property. POF transmits light in the form of electromagnetic waves whose properties like amplitude, phase, polarised state and frequency are directly influenced / affected by physical parameters like pressure, strain, stress, electric field, temperature and magnetic field. Optical fibre is a three layered cable, buffer coating, cladding and core are the inner layers of the fibre and the light transmissions carried out through the core of the fiber[5].

2) 2.2.1Material Specification

The basic material used for manufacture of translucent concrete are cement, aggregate and optical fibre. Table 2.2.1 shows the important specifications of this materials.

Table 2.2.1: Material Specification [3]

Sr.	Material	Specifications
1	Cement	53 Grade
2	sand	Passing through 2.36mm sieve
4	Concrete	M 20 Grade
5	Optical fibre	2% - 4%

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3) 2.2.2Properties of Materials

- Cement

Ordinary Portland cement was used for casting all the specimens. The important features required in translucent concrete are shown in Table 2.2.2.1

Table 2.2.2.1 :Properties of Cement [3]

Sr.	Properties of Cement	Values obtained
1	Fineness of cement as retained on 90 micron sieve	3%
2	Grade of cement	53
3	Specific Gravity	3.15
4	Initial Setting time	30min

- Sand:

Clean and dry river sand available locally is used. Sand passing through IS 4.75mm Sieve is used for casting all the specimens. The values of specific gravity and fineness modulus are shown in Table 2.2.2.2.

Table 2.2.2.2 : Properties of sand[3]

Sr.	Properties	Values obtained
1	Specific Gravity	2.53
2	Fineness Modulus	2.64

- Water: The water used was free from all impurities.

Manufacturing Process

Translucent concrete is produced out of fine-grain concrete and translucent fabric which is layer cast in pre-fabricated mould. Because of relatively small amount of fabric, solidity and consistency of translucent concrete are the same as the high-strength concrete. Almost free energy loss light penetration through optic fibres makes it possible to see light, shadows and even colours through concrete even by very thick walls. It can be produced as prefabricated building blocks and panels. Due to the small size of the fibres, they blend into concrete becoming a component of the material like small pieces of aggregate. In this manner, the result is not mixed material like glass in concrete but a new material, which is homogeneous in its inner structure as well as on its main surfaces. The optical fibres lead light by points between the two sides of the blocks. Because of their parallel position, the light-information on the brighter side of such a wall appears unchanged on the darker side. The most interesting form of this phenomenon is probably the sharp display of shadows on the opposing side of the wall. Moreover, the colour of the light also remains the same [6].

Basic Procedure

The manufacturing process of translucent concrete is almost same as regular concrete. Only optical fibres are spread throughout the aggregate and cement mix. Small layers of the concrete are poured on top of each other and infused with the fibres and are then connected. Thousands of strands of optical fibres are cast into concrete to transmit light, either natural or artificial. Light-transmitting concrete is produced by adding 4% to 5% optical fibres by volume into the concrete mixture. The concrete mixture is made from fine materials only it does not contain coarse aggregate. Thickness of the optical fibres can be varied between 2 µm and 2 mm to suit the particular requirements of light transmission. Automatic production processes use woven fibres fabric instead of single filaments. Fabric and concrete are alternately inserted into moulds at intervals of approximately 2 mm to 5 mm.Smaller or thinner layers allow an increased amount of light to pass through the concrete. Following casting, the material is cut into panels or blocks of the specified thickness and the surface is then typically polished, resulting in finishes ranging from semi-gloss to high-gloss [5].

- **Cement Mixing:-**Very fine aggregate is mixed with Portland cement of variable compressive strength concrete. Sand: cement: water ratio is 1:2:0.44. The concrete mix is then placed in mould of required size.
  Mix Ratio Of Concrete - 1.0 : 1.5 : 3.0
  Mix Ratio Of Mortar - 1.0 : 3.0

- **Placement of Optical Fibre:-**Optical fibre is then stretched in machine and with help of that machine the optical fibres are inserted in fresh concrete just after placing fresh concrete in mould as shown in Fig. 3.1.1. Optical fibre are inserted in such a way that their some of the endings part is outside the concrete.

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Fig.3.1.1 : Placement of Optical Fibre [7]

- **Cutting:**-Edges of fibre from the surface of concrete block are by cutting machine.
- **Finishing:**-The surface obtain after cutting of edge of fibre optics is quit rough, for smoothing of surface finishing is done. After all the above processes the finished concrete looks like as shown in Fig. 3.1.2[7].
- **Casting Process :** The manufacturing process of translucent concrete is same as regular concrete. The optical fibers are spread throughout the aggregate and concrete mix evenly. The combination of 2mm and 3mm diameter POF's is used with varied percentages from 0% to 3%. Optical fibers are inserted through the perforated plates into the mould in such a way that their ending part is outside the mould, which are tied firmly so that they are not bent and stay parallel to each other. After inserting the fibers the concrete mix is poured in 3 layers and compacted using external vibrator.
- **Curing:** After 24 hrs of casting concrete specimens are kept for curing in water bath with room temperature for 7 days and 28days as per standard specifications.

II. RESULTS AND DISCUSSION

1 Compression Test Results: The compressive strength of the concrete is determined.

Cube	% of fibers (2+3)mm diameter	Compressive Strength (N/mm2)	
		7 days	28 days
1	0	19.1	26.52
2	1	20	24
3	2	22.89	26.67
4	3	17.33	21.43

Table 4.1: Compressive Strength Results

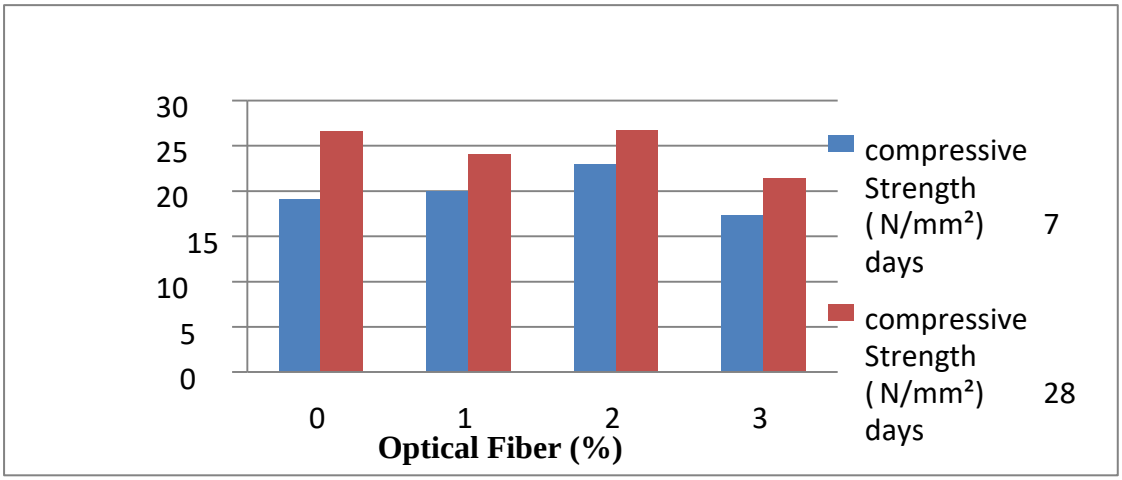

Chart 4.1: Strength Comparison of conventional concrete with translucent concrete.

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Discussion: The compressive strength of concrete with varied % of POF is shown in Table 4.1 and Chart 4.1 for 7 days and 28 days.

- ✓ It is noticed that as the % of POF increases, the compressive strength of translucent concrete is increased upto 2% of POF but further increase in POF %, the strength has decreased.
- ✓ For 7 days strength of translucent concrete of 2% POF gives 22.89N/mm2 which is 16.5% more than the conventional concrete.
- ✓ For 28 days strength of translucent concrete of 2% POF showed nearer value to target strength of conventional concrete.

4.2 Flexural Test Results:

Flexural test has been conducted for conventional concrete and 2% POF translucent concrete.

Table 4.2: Flexural Strength Results

Prism	**Flexural Strength (N/mm^2)**
Conventional Concrete	4.56
Translucent Concrete	4.77

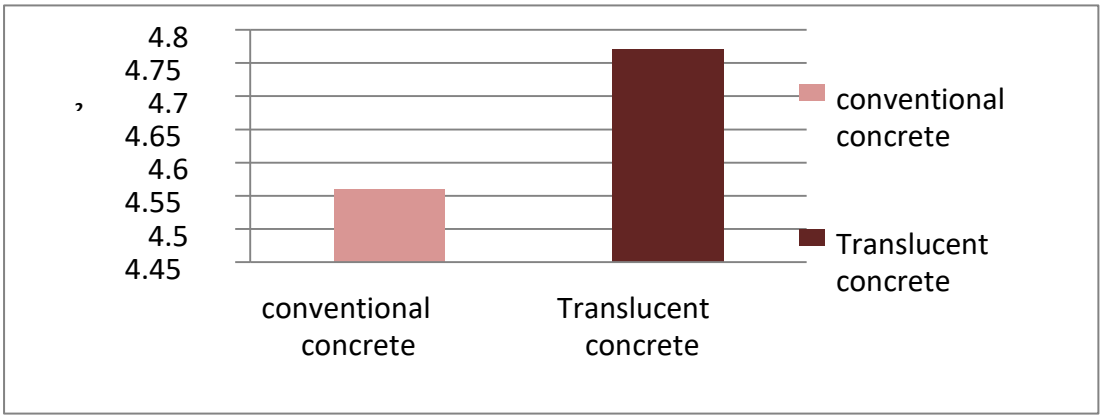

Chart 4.2: Flexural Strength Comparison of Conventional Concrete with Translucent Concrete of 2% POF.

CONCLUSION

Translucent concrete panels can be used in many ways and executive into many structure and be highly advantageous. Still, the only feedback would be its extravagant. Hence it not include on high class architects from using it. It is considerable as sign of attraction and artistic growth. With the optimal percentage of optical fiber, that is 4% concrete has slightly higher strength than the conventional concrete. And has the ability to transmit light, there by changes the image of conventional concrete. Only fine aggregates are used because if we use coarse aggregates it may damage the optical fibers and change their properties. Transparent concrete structures acceptable for load bearing walls, floors and pavements. In furniture for the embellishing and aesthetic purpose. Translucent concrete blocks used as Partitions wall, where the sunlight does not reach properly. The reason for higher cost is that optical fiber is not locally available in our country in the desired rates. Hence the deep construction is not suitable by translucent concrete, but the small constructions like partitions wall are more suitable and benefit by translucent concrete.

REFERENCES

[1]. Soumyajit Paul, Avik Dutta"Translucent Concrete", International Journal of Scientific and Research Publications, Volume 3, Issue 10, 2013, pp.

[2]. Aashish Ahuja, Khalid Mosalam, Tarek Zohdi"Computational Modeling of Translucent Concrete Panels", American Society of Civil Engineers, 2014.

[3]. R. Pradheepa,S. Krishnamoorthi"An Experimental Study on Translucent Concrete", International Journal for Scientific Research &

Development, Vol. 3, Issue 03, 2015, pp. 174-177

[4]. Saber Rahimi "Investigating the Use of Fibre Optic Sensors in Ferro concrete Structures", Technical Journal of Engineering and Applied Sciences, 2013, pp. 2796-2798

[5]. Bhavin Kashiyani, Varsha Raina, Jayeshkumar Pitroda, Bhavnaben Shah"A Study on Translucent Concrete: A Novel Architectural Material to Explore Construction Sector", International Journal of Engineering and Innovative Technology (IJEIT),Volume 2, Issue 8,2013, pp. 83-87

[6]. Anurag Shukla, Trushik Poriya, Jigar Zala "An Experimental Work On Light Transmitting Concrete", International Journal of Advance Engineering and Research Development (IJAERD) Volume 1,Issue 5, 2014.

[7]. F. Ansari " Practical Implementation of Optical Fibre Sensors in Civil Structural", Health Monitoring Journal of Intelligent Material Systems and Structures, 2007.

[8]. Shakir Ahmed Salih, Hasan Hamodi Joni, Safaa AdnanMohamed "Effect of Plastic Optical Fibre on Some Properties of Translucent Concrete", Eng. &Tech.Journal, Vol. 32,Part (A), No.12,2014, pp. 2846-2861.

[9]. Jianping He, Zhi Zhou, Jinping Ou "Study on Smart Translucent Concrete Product and Its Performances", The 6th International Workshop on Advanced Smart Materials and Smart Structures Technology, ANCRiSST2011, Dalian, China, 2011.

[10]. Zhi Zhou, Ge Ou, Ying Hang, Genda Chen, Jinping Ou "Research and Development of Plastic Optical Fibre Based Smart Translucent Concrete", Center for Infrastructure Engineering Studies, Missouri Univ. of Science and Tech., Rolla,USA, 2009.

[11]. A. Momin, R. Kadiranaikar, Vakeel Jagirdar, Arshad Inamdar "Study on Light Transmittance of Concrete Using Optical Fibres and Glass Rods", International Conference on Advances in Engineering & Technology (ICAET-2014),2014,pp.67-72

[12]. https://illumin.usc.edu/245/translucent-concrete-an-emerging-material/

