# Review Study of Light Transmitting Concrete

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***Abstract – Light transmitting concrete is also named as translucent concrete, because of its transparent property. The main purpose is to use natural sunlight as a light source to reduce the power consumption of illumination and to use optical fiber to sense the stress of structure and also use this concrete for good aesthetic view of the building as architectural purpose. At many locations, the natural availability is compromised due to utilization of space in which case artificial lighting is required to be provided for most part of day & also during the night. With depleting natural resources i.e. facilities available for generation of electrical power, utilization of natural light & air by scientific construction methods becomes very important. The transparent concrete mainly focuses on transparency and its objective of application pertains to green technology and artistic finish. It is the combination of optical fibers 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, environmental protection and energy saving***

***Keywords: Energy Saving, Plastic Optical Fiber, Smart Transparent Concrete***

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## INTRODUCTION

A smart transparent concrete - novel construction material was manufactured with POF and 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. Additionally, experiments to study the mechanical performance of the concrete infused with POF were carried out.

Litracon presents the phenomenon of light transmitting concrete in the form of a widely applicable new building material. Litracon is a combination of plastic optical fibers and fine concrete. It can be produced as prefabricated building blocks and panels. Due to the small size of the fibers, they blend into concrete becoming a component of the material like small pieces of aggregate. The POF 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.

Due to its 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. 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 transparent concrete block in 2003, named LiTraCon.

Moreover, the colour of the light also remains the same. Thousands of POF fibers form a matrix and run parallel to each other between the two main surfaces of each block. The proportion of the fibers is very small (4%) compared to the total volume of the blocks.

## PRINCIPLE

In theory, a wall structure built from light-transmitting concrete can be several meters thick, because the fibers work without almost any loss in light up until 20 meters. Load-bearing structures can be also built of these blocks, since POF do not have a negative effect on the well-known high compressive strength value of concrete. The blocks can be produced in various sizes and with embedded heat-isolation.

Due to economic development and space utilization requirements, high rise buildings and skyscrapers are mostly built downtown in metropolitan areas around the world, especially those countries with great populations. Those buildings are isolated biosphere only based on man-made lights to maintain people's optical activities. For example, China consumes 25% of global architectural energy and 13% of that energy is used to power lighting. At present, green structures focus greatly on saving energy with indoor thermal systems. However, in the area of illumination fields, there is very little research offering relevant solutions. Research on the intrinsic characteristics of the optical identity in construction materials is still at its infancy.

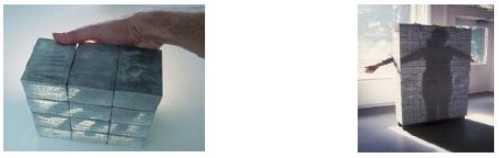

Figure 1: Picture of LiTraCon light transmitting concrete
(Courtesy of LiTraCon Bt 2001 – 2006)

## LITERATURE REVIEW:

Satish Kumar V & Suresh T : To Study of Behavior of Light Transmitting Concrete Using Optical Fiber in Light Transmitting concrete.

Dr. R.B.kadiranaikar, prof A.A. Momin, Mr.A.A.Inamdar : To Study on Transmittance of concrete using optical fibers.

**Material composition:**

### 1. PLASTIC OPTICAL FIBER:

There are three basic types of optical fibers:

1. Multimode graded-index fiber.
2. Multimode step-index fiber.
3. Single-mode step-index fiber.

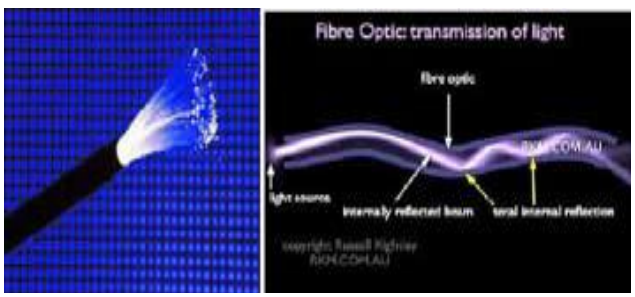


**Fig 2: Optical fibre**

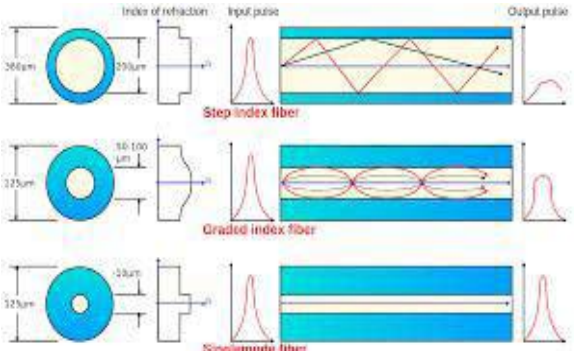


**Fig 3: Types optical fibre**

## MATERIALS:

1. **Cement:** The cement used in this experimental works is Portland cement 53 Grade Ordinary Portland Cement. All properties of Cement are tested by referring IS12269-1987 Specification for 53 Grade Ordinary Portland cement. The specific gravity of Cement was 3.14. The initial and final setting times were found as 50minutes and 545minutes respectively. Standard consistency of cement was 39.99%.

2. **Fine aggregate:** Locally available sand passed through 4.75mm IS sieve was used The specific gravity 2.62 and fineness modulus of 2.79 were used as fine aggregate. The loose and compacted bulk Density values of sand are 1601 and 1686 kg/m3 respectively, the water absorption of 0.10%.

3. **Coarse aggregate:** Crush granite aggregate available from local sources has been used The coarse aggregate with maximum size of 10mm having the specific gravity value of 2.67 and fineness modulus of 6.21 were used as a coarse aggregate. The loose and compacted bulk density values of coarse aggregate are 1501kg/ m3 respectively, the water absorption is 0.15%.

## CHARACTERISTICS

- Permits the passage of light through the set concrete, permitting colors, shapes anoutlines to be seen through it
- Having a resistance to compression that varies from150 MPa to 250 MPa
- Having maximum water absorption of 0.35%.
- Having a maximum oxygen index of 25%.

- Having a thermal conductivity of 0.21 W/m °C.
- Having an elastic limit greater than 60 MPa.
- Having a Young's Modulus from 2750 MPa to 3450 MPa
- From its characteristics and composition, can be a conductor of electricity, dispensing with interior.
- From its mechanical and optical characteristics, can be used for purposes that are both architectural and aesthetic, and also structural and under conditions of service equal to and even different from those of a traditional concrete.

## APPLICATION

- Transparent concrete shares many of the strength characteristics of standard concrete, so it can also be used for many of the same applications.
- Like concrete, chemical additives can increase the tensile strength and add to transparent concrete's uses. Although it is relatively new, transparent concrete may eventually be used in underground construction, such as subways, to allow natural light to flow underground and limit the use of electrical lighting.
- It may also be used as a lighted paving material for speed bumps, enabling drivers to see them at night.
- For now, transparent concrete is used in structural applications such as accent or exterior retaining walls and structures.

## ADVANTAGES

- Translucent concrete inserts on front doors of homes, allowing the resident to see when there is a person standing outside.
- Ceilings of any large office building incorporating translucent concrete would reduce lighting costs during daylight hours.
- Lane markers in roadways could incorporate various colors in the translucent concrete, allowing for dynamic adjustments when required by traffic fluctuations.
- The use of translucent concrete in an outer wall of an indoor stairwell would provide illumination in a power outage, resulting in enhanced safety.
- Speed bumps in parking lots and driveways could be illuminated from below, making them more visible and therefore more effective.

## DISADVANTAGES

- It is precision material and the correct procedure need to be followed.
- It is extremely important to ensure the integrity of optic strands if they break within the product property would almost be neglected.
- Costing of this material is difficult as the techniques are just start to develop.

## EFFECTS

- A wall created with transparent concrete blocks is not actually as transparent as glass. Instead, the blocks filter light, both natural and artificial, enabling you to have a solid wall that affords privacy, while allowing light to enter.
- If a person stands on one side of a transparent concrete wall, the shadow or outline can be seen on the opposite side.
- One side of the wall is darker, the shadows on the lighter side having sharper outlines.
- Any color of light may pass through the walls, and some designs can show shapes or images through the concrete as well.

## CASE STUDY

### The Italian Pavilion of Shanghai

The transparent concrete was made available to viewers at the World Expo in Shanghai. The outer walls of the Italian pavilion were a kind of unusual. Although they felt solid, and looked like concrete when viewed from an angle, light was able to pass through them. How was it possible? They were made from “transparent concrete,” and has given name as light. It’s definitely a unique substance, as it blurs the line between wall and window.

(Italian Pavilion at Expo 2010, Shangai)

3,774 transparent panels made from 189 tons of "transparent concrete" cover a total surface area of 1,887 square meters, approximately 40% of the entire Pavilion, creating a sequence of lights and shadows in constant evolution during the day. The transparent effect is more evident when it is dark and, seen from the outside, the building will allow the interior lights to filter through while, from inside, during the day, it will show the changes in the levels of daylight. The panels used in Shanghai measure 500x1000x50 mm and degree of transparency equals 20% of their surface area. Compared with static performance, based on tests carried out in the laboratory, a three-point flexural test showed that the panels can bear an elastic load of around 2KN; maximum failure load as measured from tests was around 8 KN.Each panel weighs about 25 kg.The properties of this material are undergoing further investigation by researchers in order to develop additional and more advanced applications for the product.

(Transparency of panels)

Transparent concrete was used for the first time in Shanghai, future applications of this material may include its adoption as an architectural component with diversified, integrated functions, such as, for example, internal lighting (shading/light diffusion techniques). This is the case of "transparent" buildings where the light becomes the most prominent element.

## CONCLUSION

- A novel architectural material called transparent concrete can be developed by adding optical fiber or large diameter glass fiber in the concrete mixture.
- The transparent concrete has good light guiding property and the ratio of optical fiber volume to concrete is proportional to transmission.
- The transparent concrete does not loose the strength parameter when compared to regular concrete and also it has very vital property for the aesthetical point of view. It can be used for the best architectural appearance of the building.
- It can also be used in areas, where the natural light cannot reach with appropriate intensity.
- This new kind of building material can integrate the concept of green energy saving with the usage self sensing properties of functional materials

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