# LiTraCon
# *Light Transmitting Concrete*

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***Abstract :*** LiTraCon is a trademark for a translucent concrete building material. The name is short for "light-transmitting concrete". The technical data sheet from the manufacturer says the material is made of 96% concrete and 4% by weight of optical fibers. It was developed in 2001 by Hungarian architect Áron Losonczi working with scientists at the Technical University of Budapest. LiTraCon is manufactured by the inventor's company, LiTraCon Bt, which was founded in spring 2004. The head office and workshop is near the town of Csongrád. As of 2006 all LiTraCon products have been produced by LiTraCon.

The concrete comes in precast blocks of different sizes. The most notable installation of it to date is Europe Gate - a 4 m high sculpture made of LiTraCon blocks, erected in 2004 in observance of the entry of Hungary into the European Union. The product won the German "Red Dot 2005 Design Award" for 'highest design qualities'. Though expensive, Litracon appeals to architects because it is stronger than glass and translucent, unlike concrete. It has been considered as possible sheathing for New York's One World Trade Center

## I. INTRODUCTION

Transparent concrete is a concrete based building material with light-Tran 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 reduce the power consumption of illumination and to use the optical fiber to sense the stress of structures and use this concrete as an architectural purpose for good aesthetical view of the building.

Now days, small buildings are replaced by high rise buildings and sky scrapers. This arises one of the problems in deriving natural light in building, due to obstruction of nearby structures. Due to this problem use of artificial sources for illumination of building is increased by great amount. LiTraCon (light transmitting concrete) successfully produced the first transparent concrete block in 2003, It is very essential to reduce the artificial light consumption in structure, since concrete is strong in compression and weak in tension and flexure**.**

## II. LITERATURE SURVEY

It is an architectural energy and 13% of that energy is used to power lighting. At present, green structures focus greatly on saving energy with promising technology for field applications in civil infrastructure. 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 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. Due to its outstanding light guiding and sensing advantages, such as anti-electromagnetic interference capability, small dimensions, distributed measurement and anticorrosion characteristics, optical Fiber s 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.

## III. THEORY

### 3.1 Principle

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. Principal can carry because optical fibers in the concrete act like the slits and carry the light across throughout the concrete.

### 3.2 Types of Optical Fibers

There are three basic types of optical fibers: [1] Multimode graded index fiber [2] Multimode step-index fiber [3] Single-mode step index fibers. A multimode fiber can propagate hundreds of light modes at one time while single-mode fibers only propagate one mode. Where the single-mode fibers propagate light in one clearly defined path, intermodal dispersion effects is not present, allowing the fiber to operate at larger bandwidths than a multimode fiber. On the other hand, multimode fibers have large intermodal dispersion effects due to the many light modes of propagations it handles at one time.

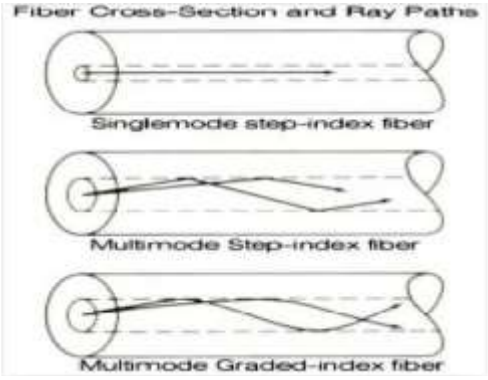


Fig no-1. Types of Optical Fibers

**3.3 Placing of Fibers and Casting of Concrete**

Initially the fibers are arranged in the required pattern in the formwork before casting of concrete. Fixing of fibers done in a plastic sheet and behind this thermo coal is placed to hold it. After installation of fiber, one end is connected to the lighting source and other end is left free on the surface of the concrete which is to be casted. Then the wet mix is applied on the slab mold prepared. Allow the concrete to cure for 7-15 days. After curing, these slabs will transmit light on its surface. Fibers are glowing at end by giving light source on another end of the fibers.

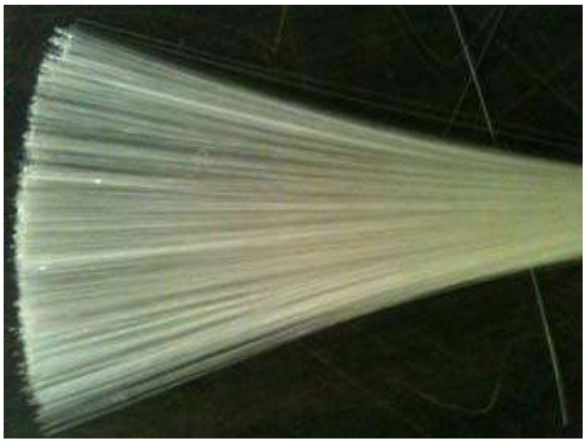
## IV. Procedure of Making Light Transmitting Concrete

**4.1 Making of Mold**

You need to roll some polymer craft clay into a flat circle. Make it as level as possible, cut out a ring from a spray paint can lid...anything that is waterproof will work. After you cut it, press it into the clay. The whole point of this is to make a mold to cast the concrete into.

**4.2 Fiber Optics**

Get one of those plastic fiber optic toys. They have that sort of 'frill' of glowing wires (see the photo). Cut a bunch small 1-inch segments.



**4.3 Placing of Fibers**

Fiber are placed individually in mold with some spacings are given due to avoiding interconnections.

**4.4 Pouring of Concrete**

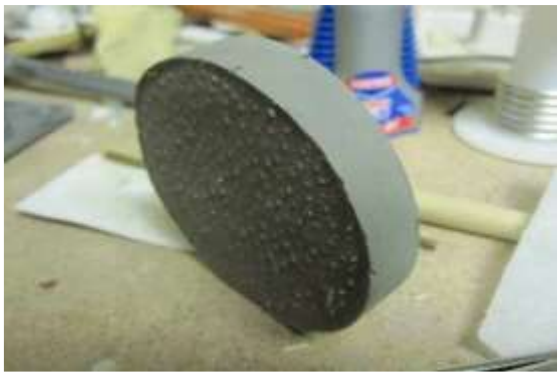
Pour the concrete carefully and slowly in fiber placed mold, the concrete is fully laid over the mold and spreading each other, there is no any air gaps.

**4.5 Breaking of Mold**

Once the concrete is cured for 24 hours, pull off the polymer clay and cut off the plastic ring. The concrete will not stick to the clay. In fact, it's practically repelled by it! That the repulsion will be easy during breaking.

**4.6 Trim the Fibers**

After you let the de-molded concrete dry out overnight, cut off the extra-long fibers.



**4.7 Polishing**

Use sandpaper to polish. Light, even colored light can pass right through and create a pixelized likeness on the opposite side.

## V. RESEARCH & DEVELOPMENT

**5.1 Workability**

The workability of the concrete is determined by conducting the slump cone test and the observed slump is 92mm.

**5.2 Compressive Strength**

The compressive strength is usually obtained experimentally by means of a compressive test. The compressive strength of the concrete is determined by cast cubes of size 150mm x 150mm x 150mm. The compressive strength of the conventional concrete and light transmitting concrete in 7, 14 and 28 days is noted.

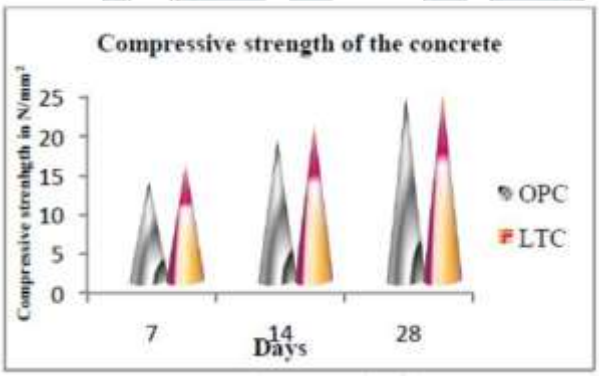



Fig no 2. Compressive Strength of Concrete

**5.3 Flexural Strength**

The flexural strength (single beam with center point load method) of the conventional concrete and light transmitting concrete in 7, 14 and 28 days and Hence the application of optical fiber will make the concrete decorative as well as can make the concrete structural efficient and the strength results of decorative concrete are correlated with results of ordinary plain cement concrete. The results evidently show that the decorative concrete also performance based on the strength aspect is also considerably high. Hence the application of optical fiber will make the concrete decorative as well as can make the concrete structural efficient.

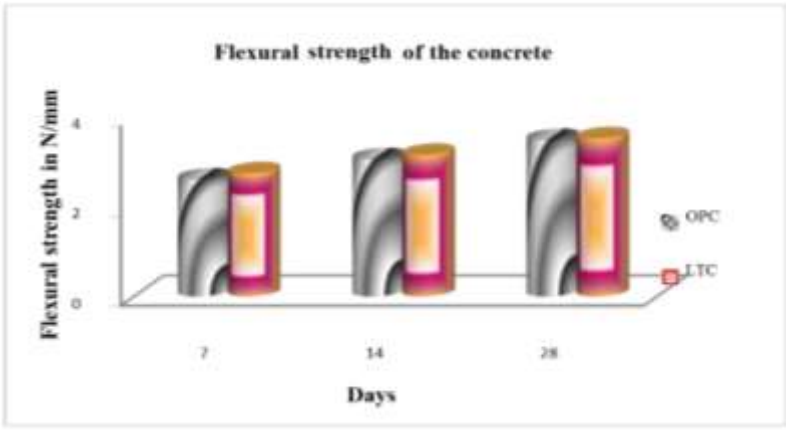



Fig no.3 Flexural Strength of Concrete

## VI. APPLICATIONS

1. Litracon building units are applicable in various areas of design.
2. Translucent concrete inserts on front doors of homes, allowing the resident to see when there is a person standing outside.
3. Translucent concrete walls on restaurants, clubs, and other establishments to reveal how many patrons are inside.
4. Ceilings of any large office building or commercial structure incorporating translucent concrete would reduce lighting costs during daylight hours.
5. Sidewalks poured with translucent concrete could be made with lighting underneath, creating lit walkways which would enhance safety, and encourage foot travel where previously avoided at night.
6. The use of translucent concrete in an outer wall of an indoor stairwell would provide illumination in a power outage, resulting in enhanced safety.
7. Subways using this material could be illuminated with daylight.

## VII. CASE STUDY

### 7.1 NEW HEADQUARTERS OF BANK OF GEORGIA

The office building is characterized by an amazing architecture and has been the headquarter of the Georgian ministry for highway engineering before becoming headquarter of Bank of Georgia, Tbilisi, with a total area of 10.960 square meters. It consists of five horizontal two-storied building parts which are arranged like stacks. Thousands of embedded optical fibers are channeling the light through the translucent concrete of wall and counter cladding. Walls, walks, receptions, offices and consultation desks are shinning and glowing from within. An office room of bank can be seen in fig.

Fig no 4. New headquarters of Bank of Georgia

## VIII. ADVANTAGES

1. Because of relatively small amount of fabric, solidity and consistency of transparent concrete are the same as the high-strength concrete.
2. Almost no energy loss light penetration through optic fibers makes it possible to see light, shadows and even colours through concrete even by very thick walls.
3. Due to the small size of the fibers, they blend into concrete becoming a component of the material like small pieces of aggregate.

4. The colour of the light also remains the same.
5. It is under fire protection classification A2 and provides very high UV resistance.
6. Totally environment friendly because of its light transmitting characteristics, so energy consumption can be reduced.
7. It has very good architectural properties for giving good aesthetical view to the building
8. When a solid wall is imbued with the ability to transmit light, it means that a home can use fewer lights in their house during daylight hours.

## IX. DISADVANTAGES

1. The concrete is very costly because of the optical fibers.
2. Casting of transparent concrete block is difficult for the labour so special skilled person is required.
3. It cannot be casted on site and hence only comes in prefabricated blocks.
4. Very rarely accepted for residential purpose by clients.
5. As it is a very new concept, no advancements in manufacturing process are yet introduced.

## X. CONCLUSION

1. A novel architectural material called transparent concrete can be developed by adding optical fiber or large diameter glass fiber in the concrete mixture.
2. The transparent concrete has good light guiding property and the ratio of optical fiber volume to concrete is proportional to transmission.
3. The transparent concrete does not loose the strength parameter when compared to regular concrete and it has very vital property for the aesthetical point of view.
4. It can be used for the best architectural appearance of the building.
5. It can also be used in areas, where the natural light cannot reach with appropriate intensity.
6. 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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