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Experimental Study on Light Transmitting Conctrete (LiTraCon)

S. Ravivarman[1], S. Deepak Raj[2], K.P. Naveen[3], B. Babu[4], A. Parthiban[5]

Abstract: ***Now days, a Small buildings are replaced by high rise buildings and sky scrapers. This arises one of the problem 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***

Keywords - Translucent concrete, optical fibre, energy saving, smart construction.

I. OBJECTIVE

To cast a special type of concrete with light transmitting properties, to study their characteristics and to develop a functioning material which is not only energy saving but gives out artistic finish.

II. INTRODUCTION

Concrete has learned to adapt to almost all new challenges that appeared. In 2001, the concept of transparent concrete was first put forward by Hungarian architect AronLosonzi, and the first transparent concrete block was successfully produced by mixing large amount of glass fiber into concrete in 2003, named as LiTraCon. Joel S. and Sergio O.G. developed a transparent concrete material, which can allow 80% light through and only 30% of weight of common concrete.

It is worth mentioning that Italian Pavilion in Shanghai Expo 2010 shows a kind of transparent concrete developed by mixing glass into concrete in 2010."LitraCon" has the strength of traditional concrete and an embedded array of glass fibres that can display a view of the outside world, such as the silhouette of a tree, for example.

Thousands of optical glass fibres form a matrix and run parallel to each other between the two main surfaces of every block. Shadows on the lighter side will appear with sharp outlines on the darker one. Even the colours remain the same. This special effect creates the general impression that the thickness and weight of a concrete wall will disappear. The hope is that the new material will transform the interior appearance of concrete buildings by making them feel light and airy rather than dark and heavy.

III. PRINCIPLE

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 fibers in the concrete act like the slits and carry the light across throughout the concrete.

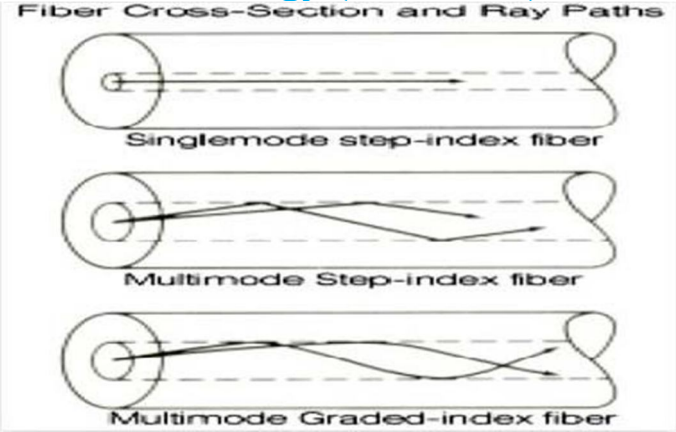
IV. TYPES OF OPTICAL FIBRES

There are three basic types of optical fibers: [1] Multimode gradedindex fiber [2] Multimode step-index fiber [3] Single-mode stepindex 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.

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Types of Optical Fibres

V. MATERIALS

Non sticky clay, Cement, OPTICAL FIBRES, Mortar, concrete, etc

VI. MIX PROPORTIONS

Mix proportions are arrived as follows: Cement – 360kg, Sand – 560kg, Fibre – 4.5kg, Water – 190lit

VII. PLACING OF FIBRES AND CASTING OF CONCRETE

Initially the fibres are arranged in the required pattern in the formwork before casting of concrete. Fixing of fibres done in a plastic sheet and behind this thermo coal is placed to hold it. After installation of fibre, 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 mould prepared. Allow the concrete to cure for 7-15 days. After curing, these slabs will transmit light on its surface. Fibres are glowing at end by giving light source on another end of the fibres

VIII. PROCEDURE OF MAKING LIGHT TRANSMITTING CONCRETE

A. Making of Mould

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.



B. Fibre Optics

Get one of those plastic fibre optic toys. They have that sort of 'frill' of glowing wires... see the photo. Cut a bunch small 1 inch segments short en masse.

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C. Placing of Fibres

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



D. Pouring of Concrete

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



E. Breaking of Mould

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

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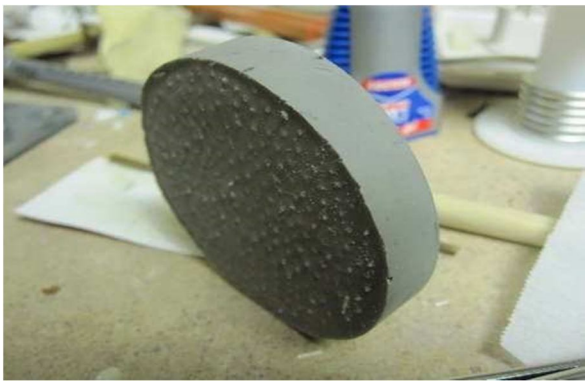
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clay...in fact, it's practically repelled by it! That the repultion will be easy during breaking



F. Trim the Fibres

After you let the de-moulded concrete dry out over night, cut off the extra long fibers



G. Polishing

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



IX. CONSTRUCTION

Transparent concrete is produced out of fine-grain concrete and translucent fabric which is layer cast in prefabricated mould. Because of relatively small amount of fabric, solidity and consistency of transparent 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

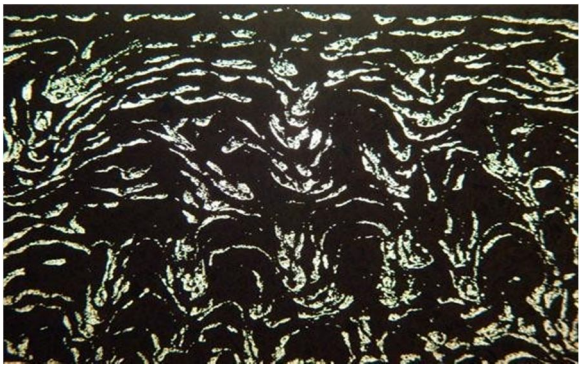
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manner, the result is not mixed material like glass in concrete but a new material, which is homogeneous in its inner structure as well as on its main surfaces. The optical fibres lead light by points between the two sides of the blocks. Because of 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

X. MANUFACTURING PROCESS

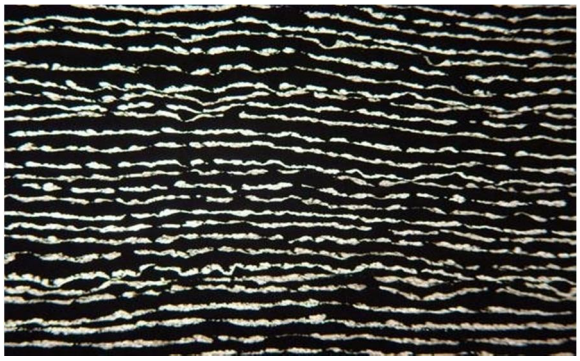
The manufacturing process of transparent concrete is almost same as regular concrete. Only optical fibres are spread throughout the aggregate and cement mix. Small layers of the concrete are poured on top of each other and infused with the fibers and are then connected. Thousands of strands of optical fibers are cast into concrete to transmit light, either natural or artificial.Lighttransmitting concrete is produced by adding 4% to 5% optical fibers 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 fibers 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 molds 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



Transparent Concrete When Optical Fibres Are In Organic Distribution

XI. OTHER PROPERTIES OF TRANSPERENT CONCRETE

There aren't many manufacturers of translucent concrete. There are very few of them, namely LitraCon, Lucon and Lucem Lichbeton. The costing of this, according to Litracon is $\$1000/m^2$ for 25mm thickness. The LitraCube lamp which is hollow cube of four interlocking panels, costs 595 euros. It is quite expensive, as it is pretty rare. But it is totally worth the cost. On the performance side, it's simply a concrete embedded with optical fibers running in a matrix while still retaining the strength of concrete. Therefore it still retains the high density top layer. It is also frost and de-icing salt resistant, making it highly recommendable in cold countries. Similarly, it is under fire protection classification A2 and provides very high UV resistance



Transparent Concrete When Optical Fibres Are In Layered Distribution

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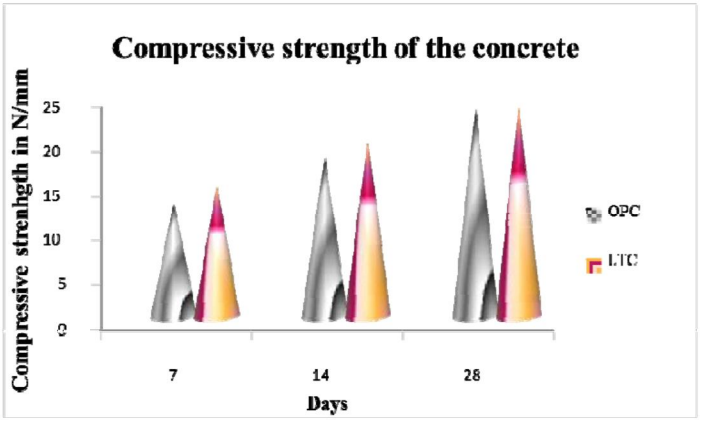
XII. EXPERIMENTAL INVESTIGATION:

A. Workability

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

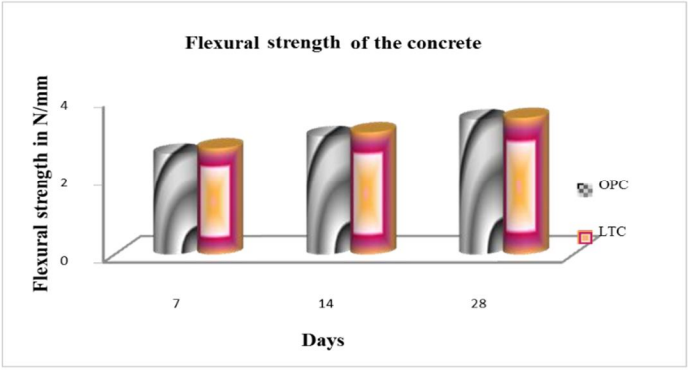
B. Compressive Strength

The compressive strength is usually obtained experimentally by means of a compressive test. The compressive strength of the concrete is determined by cast the cubes of size 150mm x150mm x150mm, The compressive strength of the conventionalconcrete and light transmitting concrete in 7, 14 and 28 days.



C. Flexural strength

The flexural strength (single beam with centre point load method) of the conventional concrete and light transmitting concrete in 7, 14 and 28 days and Hence the application of optical fibre 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 fibre will make the concrete decorative as well as can make the concrete structural efficient .



XIII. CONCUSIONS AND REMARKS

Translucent concrete blocks can be used in many ways and implemented into many forms and be highly advantageous. Yet, the only drawback would be its high cost. That doesn't stop high class architects from using it. It's a great sign of attraction and artistic evolution. Any structure with a small hint of translucent concrete is bound to make heads turn and make them stand in awe. Apart from the beauty aspects, there's also this security and supervision. Large houses, with big security walls are often low on security. That's why they are mostly fitted with electrocuted fencing Green buildings would get an easy accreditation under daylight savings with this. Large and tall office buildings can share the lighting when the ceilings are translucent. Energy savings as well as heat insulation simple adds to the list of its amazing properties. Transparent concrete is the future. It is the smart way of optimising and

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utilising light, a smart way of living. This decorative concrete can be used in interior design of buildings as panels in slabs, walls etc. The decorative concrete can be used in place of windows because it can transmit the sunlight. Hence the application of optical fibre will make the concrete decorative as well as can make the concrete structural efficient.

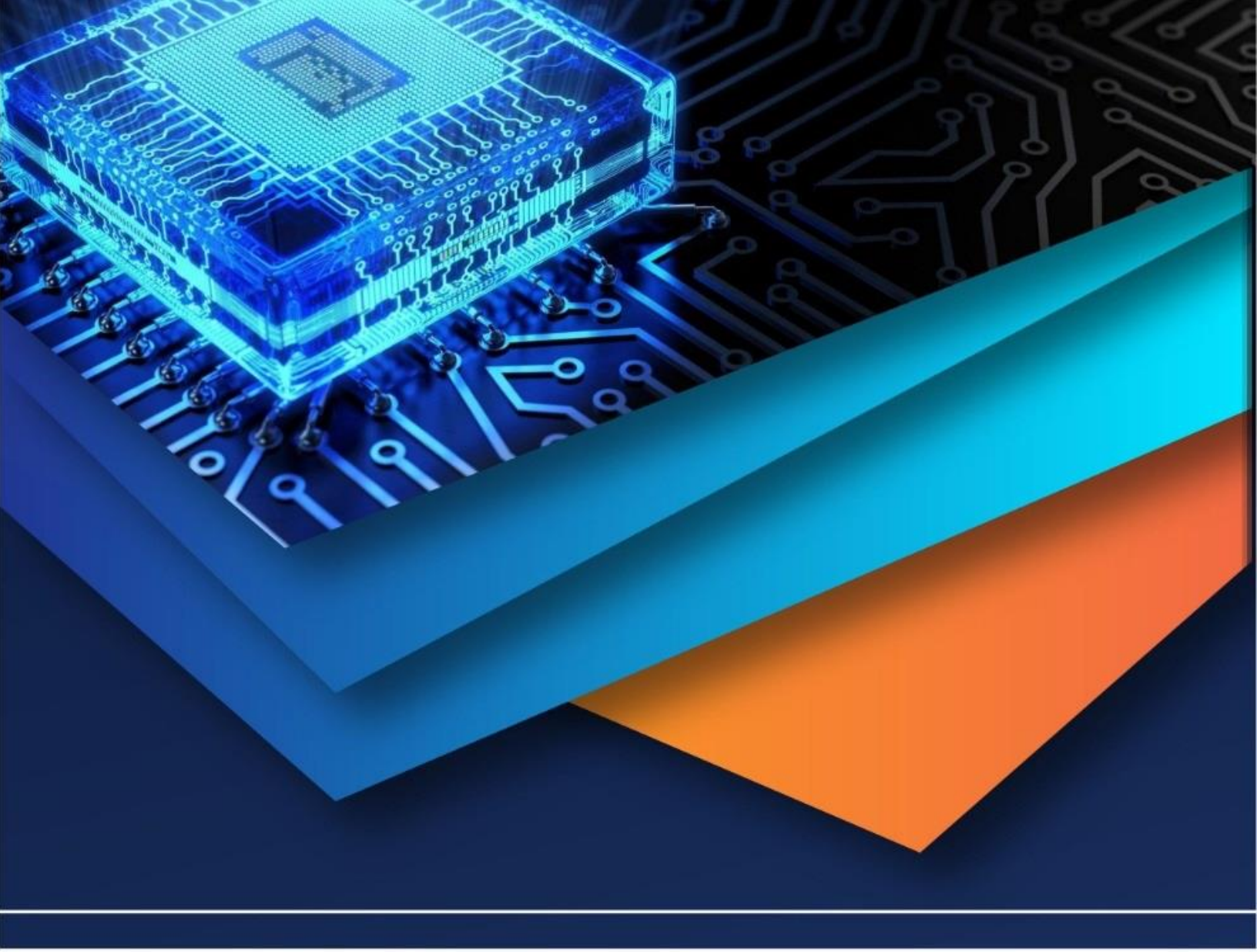
XIV. ACKNOWLEDGEMENT

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