

A GLOWING FUTURE – TRANSPARENT CONCRETE

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Energy saving and safety measurements are two key factors for infrastructure. This paper highlights the development of unique smart transparent concrete using optical fibers. Light-transmitting concrete, also known as translucent concrete, is literally the brightest concrete development in recent years. Strands of optical fibers are cast by the thousands into concrete to transmit light, either natural or artificial, into all spaces surrounding the resulting translucent panels. The material can be used in a variety of architectural and interior design applications. Smart transparent concrete can be termed 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. This paper deals with modeling of transparent concrete and their usage and the benefits brought by it in the fields of smart construction.

KEYWORDS □

Energy Saving, Optical Fiber, Smart Transparent Concrete, Fiber Bragg Grating, Green constructional material.

INTRODUCTION

Engineering as said “the science of civilization” has done major contribution in field of construction. With the increase in the population like this, when the 7 billion baby has been celebrated with joy, there is a demand for smart construction and intelligent economical alternatives. Keeping an eye on rising pollution and dropping economy, most of the building are made close to each other, in small areas like sky scrapers and high rise building. When this will do, there is very less natural sunlight passing through whereas natural sunlight is necessary for all. According to Indian green building council (IGBC), 50% day light is mandatory requirement. Transparent concrete is a marvelous idea for easier day lighting. Imagine a room built with transparent concrete on its two walls, it saves a lot of energy in the form of light as well as indoor thermal system in cold cities.

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 fiber structure. Optical fibers transmit light so effectively that there is virtually no loss of light conducted through the fibers.

A concrete block is going to be built with optical fibers in it and going to be tested for other optional properties. But the main reason or purpose of the blocks is saving energy using natural light and therefore reducing the amount of heat produced from artificial lights.

HISTORY

Translucent concrete has been first mentioned in a 1935 Canadian patent. But since the development of optical glass fibers and polymer based optical fibers the rate of inventions and developments in this field has drastically increased. 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, shown as figure 1. However, his transparent concrete did not have smart sensing properties.



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

Construction of Concrete Blocks using Optical Fibers

The first step is to make a mould for the prototype block using tin. The tin is made into a mould of the desired shape, like a cuboid here for example, with the top end open. Many holes are punched on the opposite walls of the cuboid. The optical fibers have to be passed through these holes from one end to the other and then concrete is made to set in it with the fibers inside. The light falling on one side of the block gets transferred to the other side through these many optical fibers running from one end to the other.

Usually, large chunks of blocks are made on a large scale and cemented together to form a wall or a desk or any other desired shape. Depending upon the light, the image formed is either a blurry shadow or a dull color. It cannot be a full reflection like a glass because it's only a combination of many optical fibers together projecting an image.

Usage of Translucent Concrete Blocks:

1. Translucent concrete blocks inserted on front doors or walls next to it allow the residents to see when there is a person standing outside.
2. Translucent concrete walls on restaurants, clubs, and other social establishments help see how many people are actually inside it.
3. Ceilings of large corporate buildings with translucent concrete would help reduce a great deal of lighting costs during day time.
4. Speed bumps in parking lots and highways can use translucent concrete blocks with a light source beneath or reflecting from other vehicles/sources help in navigation very effectively. Even lane markers in highways can use this material to light up the roads.
5. Sidewalks with translucent concrete fitted with a single light source beneath would add a lot to the scenic beauty as well as safety and also encourage walking or foot travel during night times.
6. Translucent concrete blocks incorporated in staircases and inner walls help during times of power cuts at night leading to a great deal of safety. Similarly for subways and airports etc., this translucent concrete blocks would add to the visibility.
7. Translucent concrete blocks can be made in desired shapes and used as decorative materials like bookshelves and sunshades, tables and statues. They can also be placed as random designs on security walls which also enhance security giving the resident a hazy view of the perimeter.
8. Lamps using translucent concrete blocks with a light source would add a great deal of aesthetic look
9. Places like schools, museums and prison cells outer walls can find translucent walls very useful as they add safety as well as security and supervision.

A Few Major Examples

Translucent concrete is a pretty rare sight. Not many people have a particular idea about this nor its applications and advantages.

1. The largest project exhibiting this technology is an artistic installation, called the 'European Gate' (2004) which was designed to mark the celebration of Hungary joining the European Union (EU). Located at the public entrance of Fortress Monostor in the Hungarian town of Komarom, this is one of the most astonished pieces of art conjugating visual lighting display as well as artistic using translucent concrete.



The European Gate at Komarom in Hungary.

One of the first projects to be ever made in a major way is this road during the day the blocks appear as concrete pavement, but at sunset they start to shine thanks to the light sources placed under them. A ringed light pattern took shape around the main square as dark came.



The illuminated road incorporated with translucent concrete underneath it.

2. More of the uses or applications include partitions or partition walls in office cabins or in houses, and attractive furniture, and intelligent light fixtures, lighting in dark subway station.



The entrance gate of Luccon, a translucent concrete company in Austria.

Advantages of Translucent Concrete Blocks/Walls

1. Natural sunlight is the God gift source for light which is actually free of cost. With translucent concrete walls in a room, it'd be brightly illuminated with natural sunlight. It's a necessary for green buildings; therefore it's beneficial for them.
2. These optical fibers also work as heat insulators, so they'll be very effective in cold countries, thereby minimizing energy and saving lots of money in both the cases.
3. Translucent concrete can help add a great deal of security and supervision in places like schools, museums and prisons etc, where the presence of the people and their actions are seen but not their entire image, thereby protecting their privacy as well.
4. Translucent concrete is aesthetically pleasing. Even a simple rectangular block of translucent concrete makes the whole place look so good and attractive.
5. Summing a few of the above, it is apparent that translucent concrete is a great tool in saving electricity and money as well. It's stronger than glass and possesses almost the same characteristic strengths of normal concrete blocks, therefore is a better replacement to it.

Conclusion 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. 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 unmatched properties. Translucent concrete is the **Glowing Future**. It is the smart way of optimizing and utilizing light, **A SMART WAY OF LIVING**

REFERENCES

- [1]. Zhi Zhou^{1,2}, Ge Ou, Ying Hang, Genda Chen, Jinping Ou., *Research and Development of Plastic Optical Fiber Based Smart Transparent Concrete*, published on Proc. of SPIE Vol. 7293 72930F-1
- [2]. Jianping He, Zhi Zhou and Jinping Ou, *Study on Smart Transparent Concrete Product and Its Performances*, proceedings of The 6th International Workshop on Advanced Smart Materials and Smart Structures Technology ANCRiSST2011 July 25-26, 2011, Dalian, China
- [3]. D.D.L. Chung - *Cement reinforced with short carbon fibers: a multifunctional material*, paper published on Elsevier, Composites: Part B 31 (2000) 511±526
- [4]. Francesca Albani *Transparent and Translucent Surfaces of Italian Architecture in the Thirties of XX Century*,

