

Application Of Transparent Concrete In Green Construction

SIDDHESH GAHRANA, VIVEK RAJ, SUDHANSHU CHOUHAN, SNESH KRISHNIA

ABSTRACT: With the increase in population there have been an aggressive increment in demand for energy but the continuous exploitation of conventional sources of energy have led to global warming and its other harmful effects. The light transmitting concrete is one such green building material which uses sunlight as its source for illumination. The light transmitting concrete is a visually appealing material. Thus while saving energy it also looks beautiful and enhances the aesthetics of area. In this paper the usage and advantages, the light transmitting concrete brings in the field of smart construction by reducing the power consumption is discussed, as being one of the modern and major component of green buildings and its importance as a revolutionary element in matching the standard of green building. It also serves the purpose of good aesthetical view of the building which earlier needed much make-over despite its versatility and popularity.

Keywords: Transparent Concrete, Eco friendly, Decorative elements, Optical Fibers, Light transmission

I. INTRODUCTION

Concrete is a composite material composed of fine and coarse aggregate bonded together with a cement paste which hardens over time. There are various types of concrete obtained by changing the proportions of the constituents of concrete. Depending on the type of structure built and the strength required mix design is adopted. With the economic growth and an increase in the population, it created a need to provide many buildings within a smaller part of land which lead to the development of the concept of skyscrapers. These skyscrapers face a problem of natural illumination and depends on artificial light. Since in these times, the need to protect the environment is a major issue in developing countries and to manage that the energy saving technology is not enough. As most of the civil engineering structures have deleterious effect on the environment therefore, in order to restore the balance in the environment several new technologies are being developed to combat this issue. The concept of transparent concrete was coined in 2001 by Hungarian architect, AronLosonzi. In 2003, he successfully produced first transparent concrete by adding 4% to 5% of glass fibre (by volume) into concrete.

The transparent block can transmit light upto 50 feet and since they occupy a small percentage of the concrete block there is no substantial loss in the structural properties of these blocks. The transparent concrete mainly focuses on transparency and its application in green technology. One can also the imagine day lighting possibilities, much lower heat loss as well as artistic applications. As the brightness of indoors of the skyscrapers is maintained by artificial light which consumes a large number of resources, the concept of transparent concrete is very useful to provide natural lights by the day and they are also economical and also with benefit of aesthetics.

Table 1 Properties of Transparent Concrete Blocks By Litracon Company

PRODUCT	Litracon- Light Transmitting Concrete
Form	Prefabricated blocks
Ingredients	96% concrete, 4% optical fibre
Density	2100-2400 Kg/m ³
Block size	600mm x 300mm
Thickness	25-500 mm
Colour	White, grey or black
Fibre distribution	Organic
Finished	Polish
Compressive strength	50 N/ mm ²
Bending tensile strength	7 N/ mm ²

Source: www.litracon.hu/productlist.php

II. MATERIAL USED IN MANUFACTURING OF TRANSPARENT CONCRETE

The materials used in the construction of transparent concrete are the same as of the traditional concrete, only it uses fine aggregates in place of coarse aggregate and secondly, the use of optical fibre (4% to 5% of volume). The optical fibre used is made up of plastic or glass. It transmits light between two ends of the optical fibre. For light transmission the thickness of optical fibre should be varied from 2 µm and 2 mm nearly equal to diameter of human hair. Concrete is produced by adding 4% to 5% optical fibre by volume in concrete mix. The new material obtained by combining the concrete and optical fibre has an important value in the application of green technology.

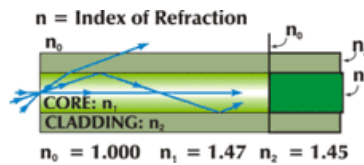
TYPES OF OPTICAL FIBRE:

1. Multimode Fibre

- SIDDHESH GAHRANA, VIVEK RAJ, SUDHANSHU CHOUHAN, SNESH KRISHNIA
 - Student, Poornima Group of Institutions, BT-1 Bio Technology Park, Sitapura, Jaipur-302022
 - Student, Poornima Group of Institutions, BT-1 Bio Technology Park Sitapura, Jaipur-302022
 - Student, Poornima Group of Institutions, BT-1 Bio Technology Park Sitapura, Jaipur-302022
 - Student, Poornima Group of Institutions, BT-1 Bio Technology Park Sitapura, Jaipur-302022
- Contact: +91-8233465149, +91-8764350178, +91-7340441412, +91-8764400625
 Email: sidgahrana@gmail.com, 2014pgicivvivek@poornima.org, 2014pgicivsudhanshu@poornima.org, 2014pgicivsnesh@poornima.org

2. Single-mode Fibre
3. Multimode Step-index Fibre
4. Multimode Graded-index Fibre

MULTIMODE STEP INDEX FIBRE:



A multimode fibre can propagate hundreds of light modes at a single time while the single mode fibre only propagate one mode.

III. MANUFACTURING PROCESS OF TRANSPARENT CONCRETE

The manufacturing process of transparent concrete is the same as that of the traditional concrete. Only optical fibres are introduced into the mould parallel to each other at a distance of 2 mm to 5 mm. Small layers of concrete are poured over one another and the fibres are infused with the concrete. Smaller layers allow an increased amount of light to pass through concrete. Thousands of fibre strands are used in the production of transparent concrete so that they are able to transmit light both artificial and natural. Coarse aggregate are not used in the production as they tend to damage the fibre strands and inhibiting the transmittance power of the concrete block. The cost of producing the transparent concrete is reduced by 5 times if plastic optical fibre are used in place of glass optical fibre but have disadvantage of less transmitting properties as compared to glass optical fibres. The combination of two extremely versatile materials provides architects a multitude of new creative possibilities.

- 96% concrete and 4% optical fibres are used to cast the Light transmitting concrete.
- Due to the small size of the fibres, they blend into concrete becoming a component of the material like small pieces of aggregate.
- Mostly quick setting cement is preferred for making concrete mix with sand and stone dust as fine aggregates.
- Craft clay is used for providing the base to optical fibre which are placed parallel.
- The concrete panels of light transmitting concrete retain all the properties of high quality concrete and can be used for interior designing. The resulting product can be used for interior or exterior walls, illuminated pavement or in art or design.

IV. APPLICATION OF TRANSPARENT CONCRETE

The present day usage of transparent concrete is limited, but some of the potential applications of transparent concrete under consideration for implementation are:

A. Illumination of interior of buildings

Dull and depressing concrete has been long associated with buildings and basements. Due to its light transmitting properties, transparent concrete has the potential to change

that cliché image of concrete and transform the interior of buildings making them appear fresh and open and spacious



Fig 1: Transparent concrete building in Sweden.

Source:http://www.architectmagazine.com/project-gallery/magasin-113_o

B. Exterior walls

Translucent concrete as front doors of homes and offices, allows the people inside to see when there is a person standing outside.



Fig 2: Transparent concrete as an exterior wall

Source:<https://www.pinterest.com/pin/437130707552566908/>

- C. Transparent concrete can be used as flooring on a surface, illuminated from below. During the day it looks like typical concrete pavement but at sunset the paving blocks begin to shine and in different colours.
- D. Sidewalks may be constructed by using transparent concrete and with lighting underneath, creating passable surface which would employ more safety of pedestrians during the night, which is at a very high risk.
- E. Transparent concrete can also be used as interior walls, facades and dividing walls based on panels.

F. Creativity with the Designing

Logos and other aesthetic structures can also be made using transparent concrete. It takes an artsy mind to design these structures. It can also be used to design floors and furniture

- G. Subways can also be illuminated which are unnecessarily dark at some places. It can also be used to create an attractive reception desk



Fig 3: Logo of LiTraCon

Source: <http://www.123seminaronly.com/Civil/Transparent-Concrete.html>

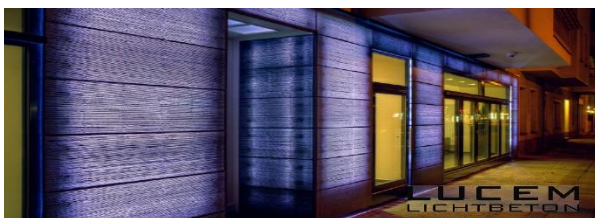


Fig 4: Artsy interior wall

Source: <https://www.lucem.com/>

V. ADVANTAGES AND DISADVANTAGES

- Transparent concrete is an excellent source for the sunlight to reach the interior of buildings and thereby reducing the power consumption during daylight hours.
- As the transparent concrete is composed of optical fibres which work as heat insulators, thus becoming more effective on cold regions.
- As the application of translucent concrete encompasses very wide area they can also be used in the security and supervision in places like restaurants and houses.
- It has very good architectural view and is also aesthetically appealing.
- Total environment friendly as it helps in reducing power consumption during daylight hours and it also work on very less energy consuming LEDs, thereby reducing energy consumption.
- Transparent concrete can be used in places where light cannot come properly and thus illuminating the whole place by natural light.
- The main disadvantage of transparent concrete is its high cost because of the optical fibres.
- The manufacturing process of transparent concrete requires both skilled supervision and skilled labour to perform the casting.

V. FUTURE EXPECTATION

As the cost of manufacturing of Light transmitting concrete is very high, it will take time for it to renovate the cityscapes anytime soon. The company is working to create more affordable translucent concrete products through future licensing deals and large scale production. Light transmitting concrete rising popularity in a short time is an

evidence to its innovation, and if the company can realize this vision, the days of dark, dull concrete may soon be coming to an end. It is not possible for everyone to use this efficient and amazing concrete. For this purpose we are trying to develop light transmitting concrete which can be afforded by everyone and have same properties as LiTracon. If more and more buildings begin using this technology, more natural light can be used to light offices and stores. This could lead to huge drops in the amount of power consumption used to light buildings, as they would be naturally lit during the day. Also, people who get exposure to the sun are generally happier and more productive, so that is another reason for businesses to use this light transmitting concrete.

VI. CONCLUSION

Translucent concrete is made by mixing optical fibres into the traditional concrete. The optical fibre strands constitute only 4 to 5 percent of the volume of the mixture, and the low percentage allows this green construction material to retain all the strength of traditional concrete. Thickness of the optical fibre can vary, resulting in more or less light transmission, allowing a range of applications. Optical fibres are highly efficient. Colours can even be used, creating a variety of possible effects. The concrete is made with 4% glass optical fibres so you can see shadows, colours and light through it. The glass optical fibres allow light to pass through the concrete no matter how thick or thin it is. It can be used as a structural component to a building or as an architectural feature. The use of the Light transmitting concrete can reduce the pollution, increase the use of resources other than conventional resources and also gives a better appearance to the structures. It provides nearly same strength with more natural light and durability. By using plastic optical fibres the light transmission may decrease but it becomes cheaper so that it can be used by all class of people and can be used widely. One of the first demonstration projects in Stockholm was to light sidewalks at night. Now people are thinking about increasing visibility in dark subway stations with the material. And there are several potential safety applications being discussed, such as lighting indoor fire escapes in the event of a power failure or illuminating speed bumps on roadways at night. Surely, as many people see its potential, light-transmitting concrete will become more and more visible. If more and more buildings begin using this technology, more natural light can be used to light offices and stores. This could lead to huge drops in the amount of electricity used to light buildings, since they'd be naturally lit during the day. It can be used as the best architectural façade of the building.

VII. REFERENCES

- [1] Akshaya B.Kamdi, Transparent Concrete as a Green Material for Building, IJSCER, Vol. 2, No. 3, 172-175, 2013.
- [2] Bhavin K. Kashiyani, Varsha Raina, Jayeshkumar Pitroda, Dr. Bhavnaben K. Shah, A Study on Transparent Concrete: A Novel Architectural Material to Explore Construction Sector, IJEIT, Volume 2, Issue 8, pp.83-87, 2013.

- [3] Juan Shen, Zhi Zhou. Some Progress on Smart Transparent Concrete, Pacific Science Review, vol. 15,no 1, 2013, pp. 51–55
- [4] Prof. A.A. Momin, Dr. R.B. Kadiranaikar, Mr.Vakeel.S. Jagirdar, Mr. Arshad Ahemed Inamdar, IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) e-ISSN: 2278-1684, p-ISSN: 2320-334X PP 67-72 www.iosrjournals.org
- [5] P.M.Shanmugavadivu, V.Scinduja, T.Sarathivelan, C.V Shudesamithronn, IJRET: International Journal of Research in Engineering and Technology eISSN: 2319-1163 | pISSN: 2321-7308
- [6] RAMANSH BAJPAI, i-manager's Journal on Civil Engineering, Vol. 4 | No.1 | December 2013 - February 2014
- [7] Dinesh W. Gawatre, Suraj D. Giri, Bhagwat B. Bande, International Journal of Engineering Science Invention ISSN (Online): 2319 – 6734, ISSN (Print): 2319 – 6726 www.ijesi.org ||Volume 5 Issue 3|| March 2016 || PP.55-62
- [8] 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.