

# Transparent Concrete

Georgia Alexandra COVALEOV

Technical University Of Civil Engineering Of Bucharest  
Adress: Bulevardul Lacul Tei 124, București 020396, Romania  
email: *andrandra@gmail.com*

**Abstract.** Reinforced concrete was invented and developed simultaneously by several people in the mid-nineteenth century. Besides versions "classical" fiber reinforced concrete (by using steel bars, whatever "style" of them), there are new ways to further concrete strength. Transparent concretes (translucent) is gaining much ground in the construction of the West Europe. "Light Transmitting Concrete" is a concrete-like product, which is translucent due to the mixture of fiber glass, plus a combination of finely divided crushed stone, cement and water. After the strengthening of composition, blocks of various shapes are obtained, with features of concrete and glass. Transparent concrete is a translucent material created by the combination of concrete and thousands of optical fiber wires acting as a filler.

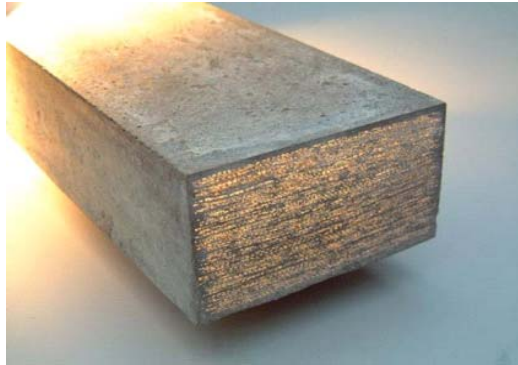
**Keywords:** transparent concrete, fiber glass

## 1 Introduction

Besides the "classic" concrete reinforcement variants (with steel bars, regardless of their "style"), there are new methods to add concrete strength. I felt a special attraction to tell about some innovative methods of applying concrete to modern constructions, combining their structural (engineering) and aesthetic (architectural) role.

Although it has not yet found a place on the Romanian market, transparent concrete (more precisely translucent) is gaining a lot of ground in the construction of Western Europe. Our Hungarian neighbors were the ones who found this way to treat an already classic building element and gradually spread it to Europe. The Italians are no less outspoken and have appeared on the market with a similar product. True, the structural role is not very well supported by this type of concrete, but if we take it together with its aesthetic role, we get an innovative product that deserves much attention.

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**Table 1.** LiTraCon ("Light Transmitting Concrete")

"Light Transmitting Concrete" is a concrete-like product, which is translucent due to the mixture of fiber glass, plus a combination of finely divided crushed stone, cement and water. After the strengthening of the composition, are obtained blocks of various shapes, with features of concrete and glass.

The process was invented and patented by the Hungarian architect Áron Losonczi in 2001. LiTraCon is produced by the inventor company, LiTraCon Bt, which was founded in the spring of 2004. The office and factory are located in the city of Csongrád, located 160 km from the Hungarian capital, the city of Budapest. All existing LiTraCon-type products up to this year were made only by LiTraCon Bt. [1]



**Fig. 2.a.** Fiberglass



**Fig. 2.b.** Fiberglass

Transparent translucent concrete is a material created through the combination of concrete and thousands of wires, optical fiber, which acts as an aggregate.



**Fig. 3.** Wires Fiber Optic

## 2 Technical data

For making translucent concrete there are two basic materials: one is from the construction region and other is from sensing region. The material used are cement, fine aggregate, aggregate dust, Optical Fiber and Water

**Cement:** Generally selection criteria of cement are based on requirement of strength and durability of concrete. The type of cement used in this type of work is ordinary Portland cement of 53 -grade, generally used for huge structures like building foundations, bridges, tall buildings.

**Fine Aggregates: Dust aggregate and Water:** For the Litracon concrete block all normal concreting sands are suitable. Fine aggregate can be natural or manufactured; the fine aggregate used, are having the specific gravity of 2.65 and passing through 4.75mm sieve. Drinkable water is used for the proper workability and binding in translucent concrete. Normal river sand as fine aggregate and 10mm-20mm aggregate size will be used as coarse aggregate.

**Optical Fiber:** Fiber optic lines are thin strands of optically pure glass or plastic and the diameter is slightly thicker than human hair. Generally optical fibers are used to pass on the light at specific wavelength. As the optical fiber used in project is plastic optical fiber made up of plastic. Optical fibers are available in market.[2]

Shape: prefabricated blocks

Ingredients: 96% fiber concrete 4% optical fiber

Density: 2100-2400 kg / m<sup>3</sup>

Compressive strength: 50 N / mm<sup>2</sup>

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Finish: Polished

Block dimensions: The maximum block size: 1200 x 400 mm

Thickness: 25-500mm

Due to the small size of the fibers, these are mixed into the concrete as aggregate. In this way, the result is a homogeneous material with good light transmission through it.

The manufacturing process of translucent concrete is same as the conventional concrete only the optical fiber are spread all through the aggregate and cement mix. Light transmitting concrete is produced by adding the 4%-5% of optical fibers by volume into the concrete mix. Initially the fibers are arranged in required pattern previous to casting of concrete. The thickness of optical fiber is in between  $2\mu\text{m}$  and 2mm which is suitable for requirement of light transmission. Smaller or thin layers permit a more quantity of light to pass through concrete. [2]

### 3 Use

Litracon can be used as building material for walls.

Litracon can be used outdoors and also for interior walls.

Due litracon hardness, it is possible to use this material as supporting structure. If necessary, strengthening litracon is also possible. Litracon products will be manufactured as insulating materials.

### 4 Translucent facade - new style n construction

Technology for the facades have evolved over time with the advent of new architectural current, and considering concepts emerged in recent years, such as ecological systems. Among the most modern are translucent facades with the ability to save energy in the indoor environment.



**Fig. 4.** Italian Pavilion at Shanghai

Europe is the area in which this idea was publicized and accepted especially for office development. Designers and builders try to add transparency, smoothness and efficiency of both new buildings and those being renovated.

Such facade has the ability to generate power, is an excellent insulator sound and offers residents the opportunity to enjoy natural light most of the day, but without having problems with the hot sun or other climatic factors.

One of the biggest problems is the protection of glass facades from sun radiation. Researchers have shown that an ideal environment for work or recreation must have a maximum temperature of 26 degrees Celsius.

The translucent concrete, as a building envelope, can offset some lighting energy that is consumed within a room in an office. It is constructed from concrete panels which are functionalized by embedding optical fibers during the manufacturing phase to transmit sunlight. From preliminary results, a volumetric fiber ratio of 6% used in the translucent concrete panel leads to savings in lighting energy by around 50%. The utility of panels is enhanced if it reduces the heating and cooling requirements of the office room. The sunlight channeled by optical fibers can contribute in heating of room during winter but in summer months, it leads to cooling. Also, daylight reduces heat dissipation from lighting installations and positively impacts cooling loads. The conduction through walls allows heat to be removed from the room during morning but transmits heat from ambient environment into the room later in the afternoon and evening. The translucent panels can cut down energy expenditure by 18% for a fiber volumetric ratio of 6% which renders the fabrication process to be practical.[3]

## **5 Environmental impact**

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. Since the insulating capacity of the wall is unchanged, the result is a net energy gain.[4]

## **6 Works made of transparent concrete in europe**

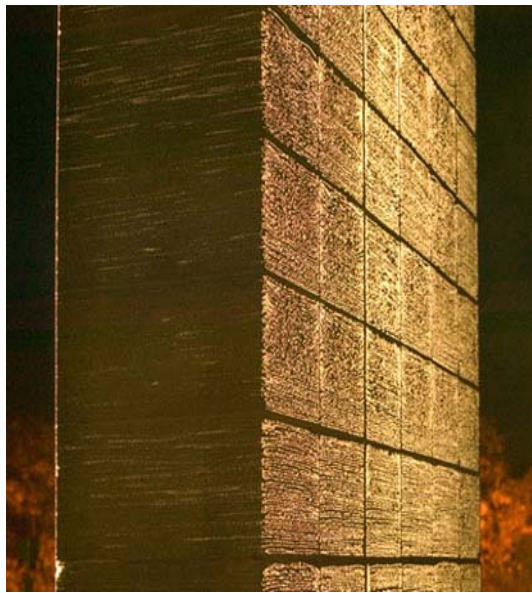
For the first time transparent concrete was put into practice in the construction of an alley in Stockholm, a work that has attracted the attention of specialists. Alley looks normal during the day but at night is unique in that it is illuminated behind concrete pieces.

The first major project in which transparent concrete was used, is Gate of Europe in Hungary, this monument was erected to celebrate Hungary's accession to the EU.

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**Fig. 5.a.** The Gate of Europe, Ungaria.



**Fig. 5.b.** The Gate of Europe, Ungaria.

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**Fig. 5.c.** The Gate of Europe, Ungaria.



**Fig. 5.d.** The Gate of Europe, Ungaria.

From a distance, it looks like normal concrete, but up close, we can see thousands of tiny holes that allow the passage of light, but do not compromise the structural strength of the material.

The Germans also took over the process and specialized in the production of transparent concrete blocks and in 2010 the Italians were the ones who built a pavilion for the World Exhibition in Shanghai from a similar material with which they hoped to revolutionize the world of materials of construction.

Both the Hungarians and the Germans used a fiber-reinforced cement, and the Italians replaced the fiber with resin, obtaining new material they intend to use, including the construction of the Bangkok embassy.

The price of a transparent concrete slab exceeds 300 euros per square meter. Innovative material has been used so far to construct the Italian flag at the 2010 Universal Exhibition in Shanghai, China .

Transparent concrete has also been used in projects around the world, including the Cella Septichora Museum in Hungary, the Hungarian Embassy in Paris, and the Iberville Veterans Parish Memorial in Louisiana. [5]

## **7 Transparent concrete works in North America**

Transparent concrete was used for the first time in North America when it was built Veterans Memorial Iberville Parish in Baton Rouge, Louisiana

Although this is still unconfirmed, architects project Freedom Tower in New York City as a new, novelty building, "dressed" in LiTraCon.

The debut of the transparent concrete prefabricated concrete in North America at Greenbuild was made by the Italcementi Group, where they introduced a new, transparent cement innovation, as well as its applications explained by designers and architects.

"The i.light walls are representative of our industry's innovation for building design developments," said Michael McSweeney, President and CEO of the Cement Association in Canada.

"The walls change our traditional perceptions of cement and concrete by presenting their possibilities and the potential to transform our communities in new and exciting ways."

Transparency in concrete is achieved through innovative technology developed by the Italcementi Group & D department. This allows the manufacture of insulated concrete panels made of concrete, which transmit light, both natural and artificial. I.light panels are guaranteed to last as long as a panel made of traditional cement.

The result of transparent panels is simply genius, as it creates a sequence of lights and shadows in constant evolution throughout the day. The transparent effect is more obvious when it is dark and is seen from the outside. The ability to transmit light leads to the use of less electricity, thus helping to save energy.

The National Museum of Construction in Washington hosts an exhibition of translucent materials that construction firms or individuals can purchase for spectacular aesthetic effects and to meet practical requirements. With the title "Transparent Stones", the exhibition presents different types of translucent concrete, a modern replica of the old building materials used so far. One of the exhibits is a wall made of translucent concrete blocks, which looks like a backlit backlight. When someone stands in front of him, the shadow of the person can be clearly seen from the other side. [6-8]



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**Fig. 6.a.** Pavilion Germany



**Fig. 6.b.** Pavilion Germany



**Fig. 6.** Pavilion Germany

## 8 Conclusions

The whole study of the type of transparent concrete can be an open door and an urge to explore this very new field in the construction world, helping to create a "friendship" and good collaboration between architects (those looking for aesthetic and appearance) and construction engineers (realists and stable builders in time). In a way, we can say that it is possible to combine the usefulness with the jeweler and at the same time make it efficient and solve (besides the aesthetic side) a great problem raised by the natural lighting of the buildings and the thermal insulation of the buildings.

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