Translucent Concrete

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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) are gaining much ground in the construction of 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 fillers.

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

2. Technical data

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

Cement: Generally, selection criteria of cement are based on the 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 a human hair. Generally, optical fibers are used to pass on the light at a specific wavelength. As the optical fiber used in the project is plastic optic fiber made up of plastic. Optical fibers are available in the market. [2]

- Shape: prefabricated blocks
- Ingredients: 96% fiber concrete 4% optical fiber
- Density: 2100-2400 kg / m³
- Compressive strength: 50 N / mm²
- 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 the 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 a required pattern previous to the casting of concrete. The thickness of optical fiber is in between 2µm and 2mm which is suitable for the 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 a building material for walls. Litracon can be used outdoors and also for interior walls.

Due to the litracon hardness, it is possible to use this material as a supporting structure. If necessary, strengthening litracon is also possible. Litracon products will be manufactured as insulating materials.
4. **Translucent facade - new style in construction**

Technology for the facades has evolved over time with the advent of new architectural currents, 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.

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 to the heating of the 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 the morning but transmits heat from the 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.

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 Bankok 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 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. 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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