



A Review on Transparent Concrete

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ABSTRACT

Transparent concrete is a concrete based building material with light-Transmissive properties due to embedded light optical elements usually Optical fibres and glass powder. Recently, the concept of green architecture has become a common interest in various disciplines. Innovative materials are continuously developed to fulfil the green architecture requirements. Transparent Concrete is a new type of Concrete used widely in the construction industry. The main purpose of transparent concrete is to use sunlight as a light source to reduce the power consumption of illumination and to use the optical fibre to sense the stress of structures and also use this concrete as an architectural purpose for good aesthetical view of the building. The Light is conducted through the stone from one end to the other. Therefore, the fibres have to go through the whole object. Transparent concrete is also known as the translucent concrete and light transmitting concrete because of its properties. It is used in fine architecture as a facade material and for cladding of interior walls etc. The concrete considered is cement mortar which contain fine aggregate and cement. The fibres are placed in shortest direction to increase the transparency of concrete. In this paper, to integrate the merits of concrete and optical fibre, for developing transparent concrete by arranging the high numerical aperture Plastic Optical Fibres or big diameter glass optical fibre into concrete. The size of optical fibre will vary between 2 μ m and 2mm. in order to increase the transparency of concrete the same amount of cement is replaced by fine glass powder. The binding capacity of glass powder and cement are same. The specimen casted will contain 95% of concrete and 5% of plastic optical fibres. We reviewed the remarkable studies carried out especially last 10 years in translucent concrete techniques.

KEYWORDS

Transparent concrete, optical fibres, glass powder, Cement, Sand, Concrete, Glass fibres, Translucent Concrete, Light transmitting Concrete, Energy Saving, Material, Sustainable Concrete, Optical Concrete, workability, Compressive Strength, Tensile Strength, Flexural Strength.

INTRODUCTION

Transparent Concrete is a new technology used in the construction industry. Concrete is a strong material that day-by-day research is increasing in this topic. It is a good and important binding material for constructing any reinforced cement concrete structures. Nowadays, we have available different types of Concrete in the market, and also day by day, researchers are done on this topic by research scholars.

Transparent Concrete is also called light-transmitting Concrete as well as translucent concrete. It has a good property, i.e., light-transmitting property. It is one of the different techniques, and it is also different from normal conventional Concrete. It is also known as LiTraCon. Transparent Concrete is originally found in the year 2001. Aron Losoczi, a Hungarian architect, first proposed the idea of transparent concrete in 2001. The first transparent concrete block, known as light transmitting concrete, was successfully created in 2003 utilising a significant amount of glass fibre. As glass and optical fibre technology advances, more work will be done on transparent concrete. Optical fibre has been added to transparent concrete, which is made of the same material as normal concrete. While optical

fibres are frequently used in concrete to boost the material's tensile strength, they are not employed in transparent concrete because it simply transmits light.

Hardened concrete that allows light to enter through it is referred to as transparent concrete. It is also known as transparent concrete or light-transmitting concrete. Optical fibre have very good light guiding and sensing capability. Transparent concrete enhances the building's visual appeal, making it fashionable in recent years. When many buildings are stacked close to each other, there is not much natural sunlight passing through and the importance of natural sunlight is pretty well known. Translucent concrete comes in as a blessing solution for easier day lighting. The light is conducted through the walls from one end to the other. Therefore, the fibres have to go through the whole object. The ornamental qualities of the light-transmitting concrete are enhanced at night when moonlight illuminates your rooms. Transparent concrete is like ordinary concrete because the strength of both concrete is the same. Generally, the internal wall is made using transparent concrete. However, it is rarely utilised for exterior walls because it could interfere your privacy.

PROPERTIES OF TRANSPARENT CONCRETE

1. High density concrete.
2. Synthetic fibres added to the mix to give some flexibility without losing strength.
3. The fibre can work up to almost 20 m running length without losing light.
4. Colour remains same on the other end of the block.
5. Versatile building material.
6. The prefabricated blocks are loaded bearing and provide the same effect with both artificial and natural light.

FUNCTIONAL PRINCIPLE OF TRANSLUCENT CONCRETE

Transparent concrete or translucent concrete is due to work based on "Nano-Optics". Optical fibers pass as much light when minute slits are placed exactly on top of each other when they are staggered. Optical fibers in the concrete act like the aperture and carry the light across throughout the concrete.

CHARACTERISTICS OF LITRACON

It would seem that creating material with properties like Litracon could revolutionize modern architecture of the same opinion was the young creator who was fully convinced that his invention would have a significant impact on the world of architecture. But he was wrong. The high cost of materials made its usage very limited. Nowadays, few objects have been made in this technology and it is old enough to be known in the whole world. In 2006 the architect got one of the most important awards in the field of design - the RedDot Design Award. After this event it was almost obvious that the material would be applicable but had encountered several obstacles in its path.

APPLICATIONS

Various applications of adding plexiglass bars with fiberglass in cement mix are listed and discussed as follows:

Transparent concrete using plexiglass bars can be employed in the

1. Architectural Facades,
2. Interior Sectors,
3. Tourist Camps ,
4. Roofs.

A high level of transparency in the proposed composite can be used to illuminate the interior space of the building by employing the surrounding natural lighting. An interactive architectural space can be created using transparent concrete slabs due to the advantage of plexiglass raw material in its ability to transfer colors from one side to another in straight or curved lines, thus the motion effect within the architectural space is transferred to the outside and vice versa.

DESCRIPTION ABOUT THE PROJECT TRANSPARENT CONCRETE

Transparent concrete is a concrete based building material with light Transmissive properties due to embedded light optical elements usually Optical fibers. Light is conducted through the stone from one end to the other. Therefore the fibres have to go through the hole

object. Transparent concrete is also known as the translucent concrete and light transmitting concrete because of its properties. It is used in fine architecture as a facade material and for cladding of interior walls. The main purpose is to use sunlight as a light source to reduce the power consumption of illumination and to use the optical fiber to sense the stress of structures and also use this concrete as an architectural purpose for good aesthetical view of the building.

MATERIALS REQUIRED

We understand that Concrete is having very fine sand particles other than coarse aggregate or coarse particles in this first one. So, the size of Concrete is very less, and it is subjected to very thin. Two factors are responsible they are one is size and the other one is shape. These are one of the important factors of transparent Concrete. In this second one, fibers are used especially optical fibers are used in place of coarse aggregates or coarse particles. The size of these fibers is very thin, and hairline and it also have glass property. In these also different types of optical fibers are available in the market.

Transparent concrete is manufactured by using a combination of fibre optics and fine concrete. These optical fibres can pass light from natural and artificial sources into spaces covered by translucent concrete panels.

The main reason for using optical fibre in concrete is that it can transmit light even at an incident angle greater than 60°. Optical fibre consists of three layers called core, cladding, and buffer coating or jacket. The light is passed through the core of the optical fibre. Transparent concrete is manufactured using fine materials only. It does not include coarse aggregates. This type of concrete has a compressive strength like that of ordinary high-strength concrete around 70 MPa (10,000 psi).

The approximate values for light transmitting concrete are given below table:

Product	Transparent or light transmitting concrete
Form	Pre-fabricated block
Ingredient	It has 96% concrete and 4% optical fibers
Density	2100-2400 Kg/m ²
Block size	60 cm x 30 cm
Thickness	25-500 mm
Colour	White, grey-black
Fibre distribution	Organic
Finished	Polished
Compressive strength	50 N/mm ²
Bending tensile strength	7 N/mm

Source: www.litracon.hu/productlist.php

Ingredients Of Transparent Concrete :

1. Cement
2. Fine Aggregate
3. Optical fiber
4. Glass powder
5. Water

1. Cement

Cement is a major ingredient of binding material used in concrete. It provides good adhesive property to bind fine aggregate and coarse aggregate. The major ingredients of cement is limestone and clay.

2. Fine Aggregate

Sands are commonly used as fine aggregate. Sand may be either natural or artificial. The fine aggregate fills the voids present in coarse aggregate and minimizes shrinkage of concrete. The size of sand particles should be between 75 micron to 4.75mm.

3. Optical Fiber

An optical fiber is a flexible, transparent fiber made of extruded glass (silica) or plastic, slightly thicker than a human hair. It can function as a waveguide, or light pipe, to transmit light between the two ends of the fiber. The field of applied science and engineering concerned with the design and application of optical fibers is known as fiber optics.

Optical fibers are widely used in fiber-optic communications, where they permit transmission over longer distances and at higher bandwidths than wire cables. Fibers are used instead of metal wires because signals travel along them with less loss and are also immune to electromagnetic interference. Fibers are also used for illumination, and are wrapped in bundles so that they may be used to carry images, thus allowing viewing in confined spaces. Specially designed fibers are used for a variety of other applications, including sensors and fiber lasers.

Optical fibers typically include a transparent core surrounded by a transparent cladding material with a lower index of refraction. Light is kept in the core by total internal reflection. This causes the fiber to act as a waveguide.

4. Glass powder

Glass powder is an extremely fine powder made from ground glass. It can be used in a number of industrial and craft applications and is often available through suppliers of glass and industrial supplies. High precision machining equipment is necessary to prepare it, as it needs to be very uniform, with an even consistency. Costs vary, depending on the level of grind and the applications. The process can involve dry or wet grinding to achieve particles of the desired size. Pigments can be added to make colored glass powders, and companies can also work with colored glass if they want to make powders of a particular color, like blue. The finished product can be hazardous and must be handled with care.

5. Water:

Water plays an important role in mixing of concrete. Water should be clean, fresh and free from organic impurities. Reduction of water increase in strength of concrete and decreases workability. The ratio of minimum quantity of water required to the weight of the cement to obtain a desired concrete mix is called water cement ratio. The standard rate of water cement ratio is 0.45 to 0.55.

ADVANTAGES

1. The main advantage of these products is that on large scale objects the texture is still visible while the texture of finer translucent concrete becomes indistinct at distance.
2. 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.
3. Energy saving can be done by utilization of transparent concrete in building.
4. Totally environment friendly because of its light transmitting characteristics, so energy consumption can be reduced.
5. resistant of compression - 50 N/mm² and bending - 7 N/mm². □
6. Blocks may have different dimensions (even 30 x 60 cm). □

7. May be construction material which allows to build several meter high walls with light transmitting. □
8. Changes in the intensity of light, referred as "light information", are transferred from the brighter side of the wall to darker side without major changes (including colour), due to the parallel arrangement of the fibres. □
9. Reduction of energy due to the penetration of daily light into the object.

DISADVANTAGES

1. The main disadvantage is these concrete is very costly because of the optical fibres.
2. Casting of transparent concrete block is difficult for the labour so special skilled person is required.
3. Compressive strength is classification as standard.
4. Square meter thickness of 2.5 cm costs about 750 euro.
5. Available only in the form of ready, it can't be made on the building site.

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