

Experimental Study on Transparent Concrete by using Plastic Optical Fiber

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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 fibers and glass powder. The light is conducted through the stone from one end to the other. Therefore the fibers 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. In this project the optical fiber size 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 glass powder has binding capacity as cement has. The specimen casted will contain 95% of concrete and 5% of plastic optical fibers. The concrete considered is cement mortar which contains fine aggregate and cement. The fibers are disturbed in shortest direction to increase the transparency of concrete. The main purpose of this project is to make a transparent concrete by using plastic optical fiber and glass powder. This work is done 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.

Keywords-Transparent concrete, optical fibres, glass powder.

INTRODUCTION

The economic growth and science technology development, more and more large-scale civil engineering structures such as tall buildings, underground buildings and landmark buildings and so on are built around the world. Those buildings are isolated biosphere only based on man-made lights to maintain people's optical activities. At the same time, most of the big buildings are built close to each other, all in the same areas, like sky scrapers. 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. By arranging the high numerical aperture Plastic Optical Fibers (POF) or big diameter glass optical fiber into concrete, optical fibers transmit light so effectively that there is virtually no loss of light conducted through the fibers.

Optical fiber has very good light guiding and sensing capability. The light is conducted through the stone from one end to the other. Therefore the fibers 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. 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.

PROPERTIES OF TRANSPARENT CONCRETE

- ❖ High density concrete
- ❖ Synthetic fibers added to the mix gives some flexibility without losing strength
- ❖ The fiber can work up to almost 20 m running length without losing light
- ❖ The prefabricated blocks are loaded bearing and provide the same effect with both artificial and natural light
- ❖ Color remains same on the other end of the block
- ❖ Versatile building material
- ❖ Illumination

I. LITERATURE REVIEW

Bhavin K. Kashiyani (2013) et al., have studied to integrate the merits of concrete and optical fiber, for developing transparent concrete by arranging the high numerical aperture Plastic Optical Fibers (POF) or big diameter glass optical fiber into concrete. 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.

PadmaBhushan M.N.V (2013) et al., in this journal paper 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. The modelling of such translucent or transparent concrete blocks and their usage and also the advantages it brings in the field of smart construction.

Prof. Momin. A.A. (2014) et al., in this journal paper the transparency of concrete specimens with glass fibers is more as compared to the specimens with glass rods and also

justifies the fact that more the transparency of the material more effective will be the light transmittance. Thus the study concludes that the transparency of light is possible in concrete without affecting its compressive strength, as the optical fibers and glass rods act as fiber reinforcement thereby enhancing the strength and also enhances appearance.

Juan Shen(2013) et al., have studied journal paper discusses the development of Smart transparent concrete based on its excellent Properties of transparent and smart sensing. By dealing with its usage and also the advantages it brings in the field of smart construction, we find that it can reduce the power consumption of illumination and 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.

Akshaya b kamdi (2013) et al., have studied paper the manufacturing, uses and future scope of transparent concrete is widely given. However, this innovative new material, while still partially in the development stages, is beginning to be used in a variety of applications in architecture, and promises vast opportunities in the future. Translucent concrete is one of the most interesting new takes on the historically stiff and uninspiring building material. It could be used almost anywhere glass or traditional concrete are used.

Basma F. Bashbash (2013) et al., have studied the development of a light transmitting concrete using plastic optical fiber (POF) is discussed and producing a new alternatives to entrench the concept of sustainability in Gaza Strip, which will help to reduce the consumption of electric energy in closed environments based on the traditional means of lighting, which can manufacture some parts of the exterior walls of the molds are made of concrete, transparent and that allow the entry of the nature lighting from outside to the inside. The experimental results show that an optical fiber can be easily combined with concrete and that the POF could provide a steady light transmitting ratio. This paper also discusses the mechanical effects of introducing POF into concrete specimens. Because the smart transparent concrete can be regarded as a “green” energy saving construction material it is a promising technology for field applications in civil infrastructure.

II. DESCRIPTION ABOUT THE PROJECT TRANSPARENT CONCRETE

Transparent concrete is a concrete based building material with light Trans missive 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 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. 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.



Fig. 1 Transparent Concrete

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 course aggregate. The major ingredients of cement is limestone and clay.



Fig. 2. Cement

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.



Fig. 3..fine aggregates

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

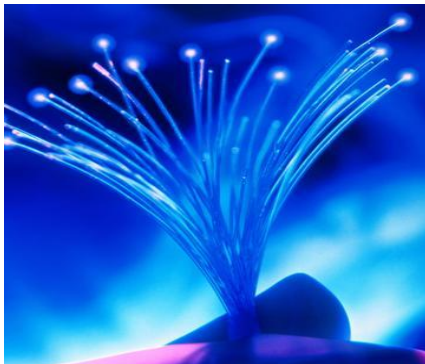


Fig. 4. Optical fibre

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.



Fig. 5. Glass powder

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

III. TRANSPARENT CONCRETE MIX PROPORTION

In transparent concrete 95% space is occupied by cement mortar, i.e. cement and sand. The remaining 5% is occupied by plastic optical fiber (POF). To increase the transparency of concrete cement is replaced by glass powder. Based on trial mix design the binding solution proportion will vary.

IV. SUMMARY AND FUTURE WORK

Transparent concrete can be developed by adding optical fibre or large diameter glass fibre in the concrete mixture. The transparent concrete has good light guiding property and the ratio of optical fibre volume to concrete is proportion to transmission. The transparent concrete not loses the strength parameter when compared to regular concrete and also it has very vital property for the aesthetical point of view. It can be used for the best architectural appearance of the building. Also used where the light cannot reach with appropriate intensity. This new kind of building material can integrate the concept of green energy saving with the usage self-sensing properties of functional materials. In the first phase I have completed the study of literature review, material collection and some basic test.

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