

**EXPERIMENTAL STUDY ON LIGHT TRANSMITTING CONCRETE BY USING OPTICAL FIBRE****S. Suganya\* & S. Minu Gopika\*\***

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**Abstract:**

Light transmitting concrete is one of the fibre reinforced concrete which is mainly used for aesthetic application by incorporating the optical fibres in concrete. Optical fibres help to transmit the light through the fibres and the end-light type of fibre is used to increase the aesthetic appearance of the concrete which is like a transparent concrete. Fibres are arranged in different layers, to increase the load carrying capacity and also the pattern can be created to make the concrete decorative and economic since it can be installed at a very low cost. This new kind of building material can integrate the concept of green energy saving with the usage self-sensing properties of functional materials. In this paper there are three cubes of size 10cm x 10cm x 10cm were made, using wooden moulds, and two of these cubes were of regular concrete and one was of transparent concrete. In transparent concrete the optical fibers were distributed in horizontal direction. They constituted 1% volume of the concrete cube. For transparent concrete cube, each cube separated by perforated plates through which the optical fibers were passed. The compressive strength of these cubes was found out by means of Compression Testing Machine.

**Key Words:** Light Transmitting Concrete & Optical Fibre

**1. Introduction:**

Energy conservation has become a considerable issue in the world today. A study estimated that by 2050, the carbon released by commercial, institutional and residential buildings will amount to 3800 tones and this carbon will consume 38% of the global energy. To reduce the consumption of energy by buildings and the upcoming construction in future, development of a new construction material which will consume less amount of energy has attracted the attention of many researchers. Concrete is one of the most basic materials required during all types of construction. Transparent concrete is such an innovative concrete which has the ability of letting light to pass through it. Concrete is made transparent by embedding optical materials such as optical fibers in it. This is because optical fibers can transmit sunlight without any heat, light or photochemical reaction. The light gets transmitted from one end of the optical fiber to another. Because of its light transmitting ability translucent concrete is also known as transparent or light transmitting concrete. Aron Losonzi was the first person to put forward the concept of transparent concrete in 2001. The first transparent concrete block was named as LiTraCon. The optical fibers were distributed to the concrete in layer by layer uniformly throughout the surface of concrete block. The compressive strength of transparent concrete block was then compared to that of control concrete block. It was observed that the compressive strength of transparent concrete was same as that of regular concrete. With 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. While the economic growth is a kind of extensive growth high input, high consumption and high pollution, for that the energy saving technology is low, especially in developing countries. The brightness of indoor environment is entirely maintained by artificial lighting, which has consumed a large number of resources.

**2. Experimental Program:**

**2.1 Materials:** Materials used for this experiment are as usual for normal conventional concrete that are cement, fine aggregate, water and optical fibre for light transmitting concrete. Optical fibres are flexible transparent fiber made up of glass or plastic (as thin as human hair). It transmits light between two ends of the fiber by process of total internal reflection. so effectively that there is almost no loss of light conducted through the fiber.



Figure1: Optical Fibre

**2.2 Mix Proportions for Transparent Concrete:** Production of mix (normal concrete of grade M- 20) in the laboratory is carried out by IS method of concrete mix design (IS 10262-1982). Transparent concrete is produced by adding optical fibres in different percentage (i.e. 4% and 5%) replacement in concrete. To achieve the strength of 20  $M_{pa}$  the quantity of materials arrived as

Cement = 0.479 kg, Sand = 0.719 kg, Water = 0.239 lit, Quantity of fibre required = 0.007 kg

**2.3 Test Procedure:** There are three specimens of size 10x10x10 cm are prepared. Small layers of the concrete are poured into the mould and on top of each layers a layer of fiber is infused. Fiber and concretes are alternatively inserted into the moulds at intervals of approximately 2mm to 5mm. Light transmitting concrete is produced by adding 4 to 5% of optical fibers by volume into the concrete mixture. The concrete mix is made from fine materials and does not contains coarse aggregate. Strands of optical fibers are cast into concrete to transmit light. Smaller or thinner layers allow an increased amount of light to pass through the concrete.



Figure 2: Concrete with Optical fibre model

After curing, period of 7 days, 14 days and 28 days, has been done concrete cubes were tested in Compression testing machine of 2000 KN capacity .

### 3. Result and Discussion

A cube compression test is performed on standard cubes of conventional concrete and transparent concrete with fully replacement of fibre at 4% and 5% and size 100mm x 100mm after 7 days and 28 days of immersion in water for curing. The compressive strength of the specimen is calculated by the following formula:

$$f_{cu} = P/A$$

Where, P = Failure load in compression (KN)

A = Loaded area of cube (mm<sup>2</sup>)

Curing days / Type of concrete	7 days	14 days	28 days
Conventional Concrete	216.6	300.3	416.6
Transparent Concrete	218.3	303.2	420

We can see that transparent concrete were performing a compression strength as conventional concrete in the above table.

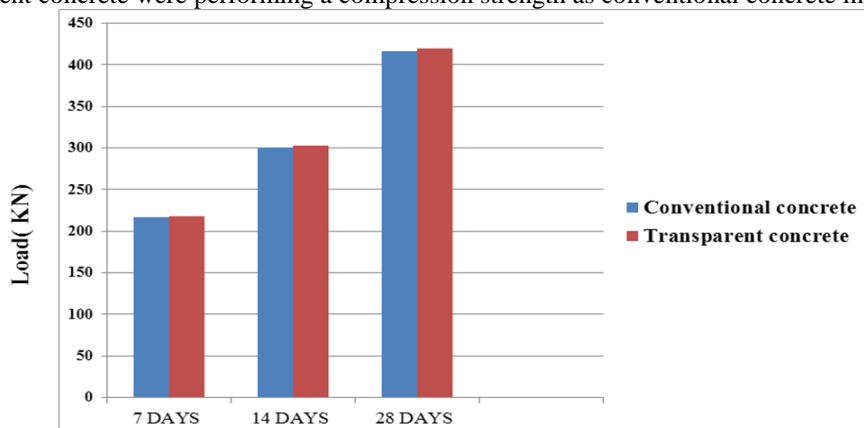


Figure 3: Compressive strength of concrete

### Properties of Light Transmitting Concrete

Product	Litracon-Light Transmitting Concrete
Form	Prefabricated blocks
Ingredients	95% concrete, 5% optical fiber
Density	2100-2400 Kg/m <sup>2</sup>
Block size	100mm x 100mm
Colour	White, Grey or Black
Fibre distribution	Organic
Finished	Polished
Compressive strength	315 KN

From tabulated results and graph drawn according to the tables, it can be conclude that the compressive strength of concrete block reduces with the increase the percentage of fibers.(i.e. percentage of surface area of concrete block)used in concrete block. As per observation and comments discuss in previous points further project work was carried out on 4% and 5% of fibers.(i.e. percentage

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of surface area of concrete block), because for 5% fiber the compressive strength is slightly reduced than target strength and for 4% it is slightly higher than target strength.

**4. Conclusion:**

The transmission of light through light transmitting block is depend on percentage of optical fiber used of that surface area. The transmission of light is increases with increase in percentage of optical fiber. The intensity of light passing through the block is maximum at 12P.M. Today the light level is more common in the range 500 - 1000 lux - depending on activity. For precision and detailed works, the light level may even approach 1500 - 2000 lux. Outdoor light intensity ranges from 0 lux to 1193 lux in day time between 7:00 A.M to 7:00 P.M. The average value of transmission of light through block is sufficient for daily activities such as general visits, Normal Office Work, PC Work, Detailed Drawing Work, Very Detailed Mechanical Works, Performance of visual tasks of low contrast and very small size for prolonged periods of time and at location such as Supermarkets, Mechanical Workshops, Office Landscapes, Study Library, Groceries, Show Rooms, Laboratories, Warehouses, Homes, Theaters, Archives, Classes. This diffused light is very useful for the place where mainly computer work is done.

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