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A Study on Translucent Concrete Product and Its Properties by Using Optical Fibers

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ABSTRACT:- *Translucent concrete is a concrete based material with light-transferring properties, obtained due to embedded light optical elements like Optical fibers used in concrete. Light is conducted through the concrete 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. This paper deals with the modeling of such translucent or transparent concrete blocks and panel and their usage and also the advantages it brings in the field. 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 of the building.*

Keywords: *Translucent concrete, Optical fibers, Compressive Strength, Nondestructive Testing.*

I. Introduction

In 2001 by Hungarian architect AronLosonczi was First invented the translucent concrete at the Technical University of Budapest by using optical fibers into the concrete. LiTraCon is a first transparent concrete block produced in 2003 by using the optical fibers. Due to globalization and construction of high-rise building, the space between building is reduced; this causes to increasing the use of non- renewable energy sources, so therefore there is a need of smart construction technique like green building andindoor thermal system.

Translucent concrete is new technique different from normal concrete. Translucent concrete allow more light and less weight compared to normal concrete. The use of sunlight source of light instead of using electrical energy is main purpose of translucent concrete, so as to reduce the load on non- renewable sources and result it into the energy saving.Optical fibers is a sensing or transmission element, so decrease the use of artificial light , the normal concrete is replaced by translucent concrete, which has natural lighting and art design.

Light transparent concrete is produced by adding 5% optical fibers by total weight of cement into the concrete mixture. Translucent concreteelement is going to be tested for other properties like compressive strength, NDT(Ultrasonic pulse velocity) Fig. 1 shows a typical sample of a Light transparent concrete through optical fibers.

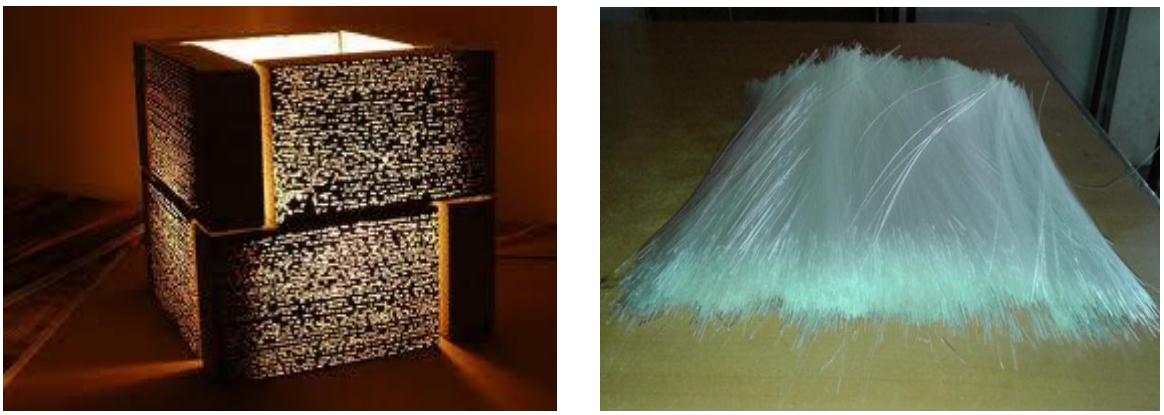

Fig.Smart Translucent Concrete.

II. Principle Of Operation

Optical fibers transmit the light along its axis from one end to other . It work as a cylindrical wavelength by the process of internal reflection as shown in fig. 2

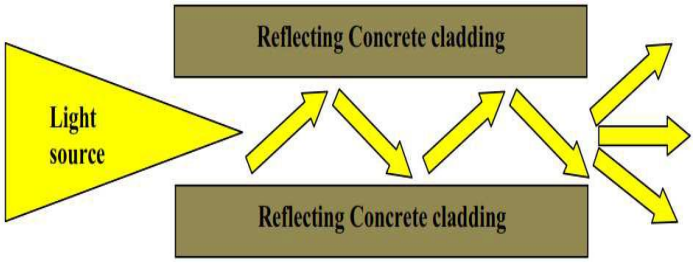

Fig.2 Total internal reflection

III. Materials And Procedure

A. MATERIALS

1. Cement

The cement used in this experimental works is "Koromandal King 53 Grade Ordinary Portland Cement". All properties of Cement are tested by referring IS 12269-1987 Specification for 53 Grade Ordinary Portland cement. The specific gravity of Cement was 3.14. The initial and final setting times were found as 51minutes and 546minutes respectively. Standard consistency of cement was 40%.

2. Fine aggregate:

Locally available sand passed through 4.75mm IS sieve was used. The specific gravity 2.75 and fineness modulus of 2.80 were used as fine aggregate. The loose and compacted bulk Density values of sand are 1600 and 1688 kg/m^3 respectively, the water absorption of 1.1%.

3. Coarse aggregate:

Crush granite aggregate available from local sources has been used . The coarse aggregate with maximum size of 10mm having the specific gravity value of 2.6and fineness modulus of 5.60 were used as a coarse aggregate. The loose and compacted bulkdensity values of coarse aggregate are 1437 and 1556kg/m^3 respectively, the water absorption of 0.4%.

4. Optical Fibers Elements:

Core - The thin glass center of the fiber where the light travels is called core.
Cladding - The outer optical material surrounding the core that reflects the light back into the core. To confinethe reflection in the core, the refractive index of the core must be greater than that of the cladding.
Buffer Coating – This is the Plastic coating that protects the fiber from damage and moisture.
Fig. 3 shows the different part of optical fiber and ray path.

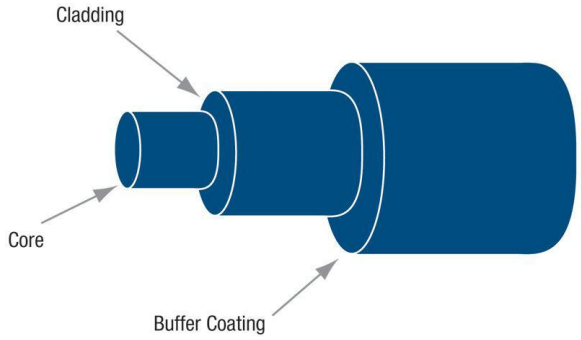

Fig.3 Fiber cross section

Types of optical fiber:

There are three basic types of optical fibers:
[1] Multimode graded-index fiber.
[2] Multimode step-index fiber.
[3] Single-mode step-index fibers.

5. Mixture proportion:

In present work Indian standard method (IS 10262-2009) is used for mix design ,mix proportion are as follow.

Cement	Sand	Coarse Aggregate	Water
1	1.25	2.9	0 .40

B. PREPARATION OFMOULD AND PANEL

Preparation of mould:

In the process of making light transmitting concrete, the first step involved is preparation of mould. The mould required for the prototype can be made with different materials which can be of either tin or wood. In the mould preparation, it is important to fix the basic dimensions of mould. The standard minimum size of the cube according to IS 456-2000 is15cmx15cmx15cm for concrete. In the mould, markings are made exactly according to the size of the cube so that the perforated plates can be used. Plates made of sheets which are used in electrical switch boards is used which will be helpful in making perforations and give a smooth texture to the mould, holes are drilled in to the plates as shown in Fig. 4 The diameter of the holes and number of holes mainly depends on percentage of fiber used.

Fig.4Preparation of mould.

Procedure of making translucent panel:

Step 1-Preparation of the Mould:

Make the required size of rectangular mould from wood or tin. Place the clay mud into the mould up to half of height of mould.

Fig.5 Preparation of panel.

Step 2- Optical Fiber:
Cut the optical fibers more than the thickness of panel.

Fig.6 Optical Fibers.

Step 3- Fixing the Fibers:
Fiber is placed or press in clay mud as shown in fig.7.

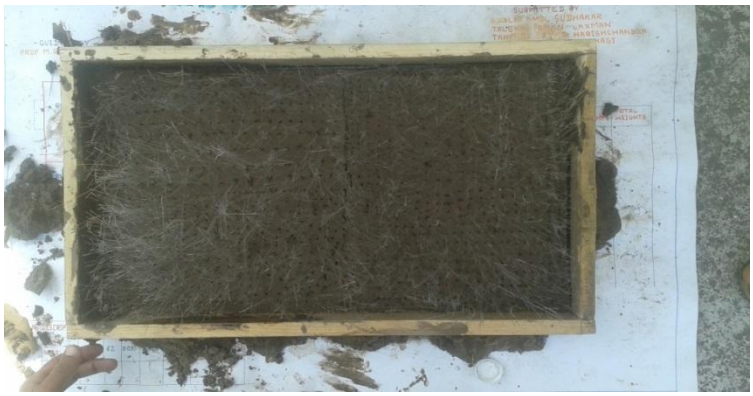

Fig.7 Fixing of fibers.

Step 4- Concreting:
Pouring the concrete mixture in smaller or thinner layer carefully in mould.
Step 5- Removing the Mould:
After 24 hrs. Remove the mould and pull off the mud.
Step 6- Cutting and polishing:
Cut the extra-long fibers same as thickness of panel. Polished the panel surface by using polish paper as shown in fig.8.

Fig.8 Polish panel.

IV. Results And Discussions

The compressive strength for concrete cubes with and without Optical fibers has been calculated for3, 7 and 28 days. From the test results, it is observed that compressive strength for 3, 7 and 28 day with Optical fibers is 8.82 N/mm^2,11.45N/mm^2 and 21.10N/mm^2 respectively. That for Conventionalconcrete is 9.56 N/mm^2,13.02N/mm^2 and 23.24N/mm^2 respectively.

The Nondestructive test conducted on concrete panel by using ultrasonic pulse velocity method. It is observed that the concrete quality grading is medium as per IS 13311 (part 1):1992 used for nondestructive testing of concrete.

V. Conclusions

- Translucent concrete is smart way of architectural& aesthetical evolution.
- The optical fiber used for transmission of light doesnot affect much reduction in strength of concrete.
- Weight of Translucent concrete is same as conventional concrete. It can be used in many ways and be highly advantageous due to power saving. That's why green buildings would get an easy accreditation.
- Translucent concrete achieve utilization and optimization of light.
- Translucent concrete resist induced effects i.e. electromagnetic effects.

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