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An Experimental Study on the Compressive Strength of Light Transmitting Concrete

Gowrisankar C
Mtech .Construction Technology And Department
VIT University Vellore, India.

Abithameenal N
Mtech .Construction Technology And Department
VIT University Vellore, India.

***Abstract*—With the world looking towards better, beautiful, strong and energy saving building materials, Engineers all over the world are experimenting in different construction materials. Making the building energy efficient is also one of the leading experiments being carried out. The incorporation of optical fibers in fine concrete makes the concrete strong, attractive, energy efficient and eco-friendly. The aim of the transparent concrete is to focus on green technology and artistic finishes in buildings. This concrete is found to reduce the energy requirement of building in terms of lux. Our project aims to manufacture the Light transmitting concrete blocks and to conduct the necessary testing for it. We have also compared the mechanical properties of normal concrete Vs light transmitting concrete. In this paper we have discussed the complete method from casting of concrete to conducting the necessary test and arriving conclusions.**

***Keywords*— Transparent concrete, light, fiber, compression strength.**

1. INTRODUCTION

With the population growing faster, the density of buildings is becoming more and more. Adding to this the geographical condition and the alignment of buildings makes the outdoor light difficult to illuminate indoors. This is the main reason for the high consumption of electricity. India approximately spends 20% of the electricity generated for the lighting purposes alone. Proper management of light sources has become crucial to cut down the unbearable electricity expenses. Light transmitting concrete serves as a onetime solution to leive the higher electricity bills. it also reduces the dead load of the structure and also improves the aesthetic property of the building. Losonczi was the first person to produce the first transparent concrete block within two years of pitching the idea. This new material was called LiTraCon, and soon became popular in many countries like Italy, Germany, and China.

II. PRINCIPLE

Transparent concrete works on the principle of total internal reflection. When a light enters from one side of the fiber, it undergoes multiple internal reflection and reaches the other end of the fiber.

This is how the transparent concrete is able to transmit the outdoor light from outside to inside the building.

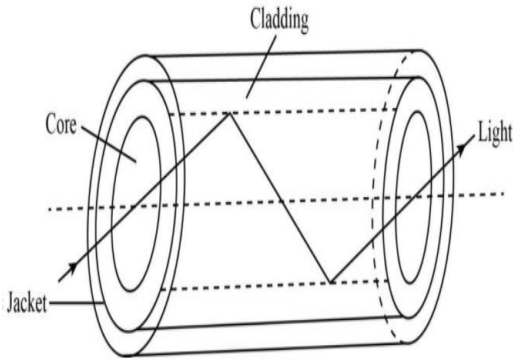

Fig 1**:** Total Internal Reflection

III. Methodology

Fig 2**:** Methodology

IV. MANUFACTURING PROCESS:

A. PREPARATION OF MOULD

The manufacturing of the light transmitting concrete is the same as that of the normal concrete, except for the design of mould. Since the optical fibers are to be incorporated in the concrete , the mould has be to redesigned such that one of its two opposite sides should have holes for the fibers to be inserted into the concrete. 3 mm holes were drilled with

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spacing of one cm between 2 adjacent holes. The below given image shows the customized mould.

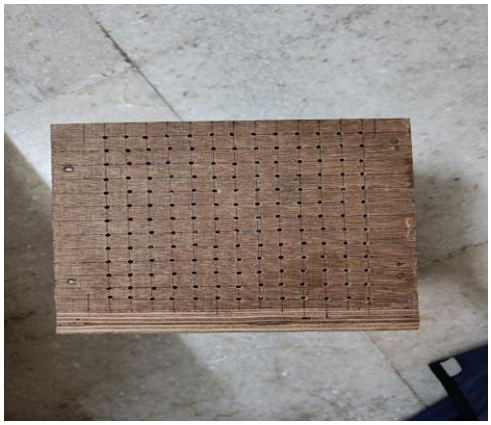

Fig 3 : Wooden mould with holes drilled in it.

B. CUTTING THE FIBERS

The fibers used in our transparent concrete are plastic optical fibers with diameter 0.03 inches. The fibers are approximately cut in 26 cm length and the image of the same is given below.

Fig 4 : Plastic optical fibers

C. MIX DESIGN

The general specifications of the concrete ingredients are given below.

D. MATERIALS USED

Grade of cement	OPC 53
Garde of Sand	ZONE 3
Size of aggregate	10mm
Grade of concrete	M 20
No of cubes	9

Table 1: list of materials used

E. QUANTITY OF MATERIALS

S.NO	MATERIAL	QUANTITY
1	cement	1.8 kg
2	Coarse aggregate	4.2 kg
3	Fine aggregate	3.57 kg
4	water	0.9 l

Table 2 : Quantity of materials

F. PREPARATION OF CONCRETE

The concrete was dry mixed thoroughly with help of the concrete mixer for thirty minutes and then transferred into the concrete tray.

Fig 5 : Dry mixing of concrete

G. PLACEMENT OF CONCRETE

The dry mixed concrete is then added with water to the required amount and mixed thoroughly to obtain wet concrete ready to be casted.

Fig 6: Wet mixing of concrete

The customized mould was well greased with concrete on its inner layers to avoid stickiness between the concrete surface and the wooden mould.

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Fig 7: Greasing the mould.

The fibers 4 numbers per hole was inserted for the first 50mm depth of the mould.

Fig 8: Inserting fibers in the mould

Then the wet mix concrete is placed till the first layer of the concrete layer.

Fig 9: Placing first layer of concrete mix

The same procedure was repeated for the next 2 layers of the concrete mould and the surface is well finished.

Fig 10: Finishing the concrete surface

Fig 11: Demoulding the concrete

H. CURING

The concrete cubes after 24 hours of casting were demoulded and placed in the curing tank. The image of the concrete cubes being demoulded and present in the curing tank is given below.

Fig 12: Curing the concrete specimen

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V. RESULTS

The cured samples were air dried and tested for its compressive strength in a compression testing machine. The images are attached below.

Fig 13: Specimen kept in compression testing machine

Fig 14: Compression load being applied to the specimen

CUBE	COMPRESSIVE STRENGTH		
	DAY 7 N/mm^2	DAY 14 N/mm^2	DAY 28 N/mm^2
CUBE 1	14.08	19.91	23.51
CUBE 2	14.93	18.17	23.73
CUBE 3	14.62	18.93	24

Fig 15: Compression testing results

VI. DISCUSSION

From the test results, we can observe that 7 day strength of the concrete cubes with the incorporation of 1% fibers to the volume of concrete is approximately 14.5 N/mm^2.The 14 day strength of the concrete cubes is approximately 18.7 N/mm^2 and the 28 day strength of the concrete cubes is approximately 23.65N/mm^2.

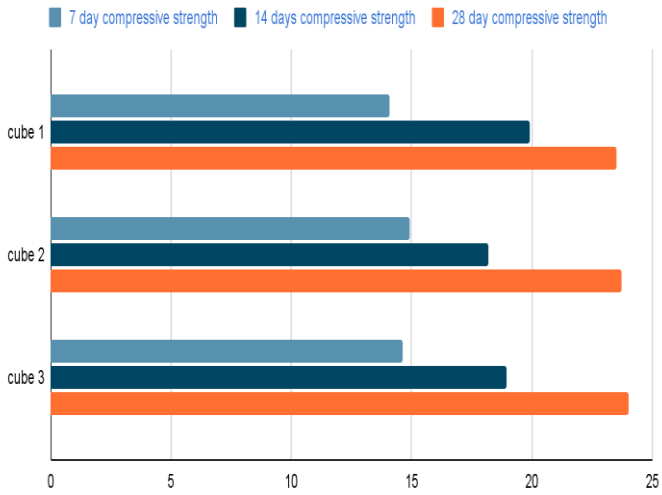

Fig 16: Compression testing results

Fig 17: Light transmission in concrete

VII .APPLICATIONS

- Pavements
- Load-bearing walls.
- Facades
- Interior wall cladding and dividing
- Partitions wall
- Light fixtures
- Furniture for decorative purposes
- Light sidewalks at night
- Speed bumps on roadway at night
- Lighting indoor fire escapes
- Dark subway stations

VIII. CONCLUSION

From the results, we can conclude that the compressive strength of the concrete is appreciably higher than that of the ordinary concrete upon incorporation of fibers at a volume of 1 %. This concrete not only improves the compressive strength but also enhances the light transmitting property in concrete. Due to its high cost of implementation, it's not widely used. But we must understand that helping the world to conserve energy by cutting down the unwanted electricity bills with this one time investment.

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