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STUDY ON TRANSLUCENT CONCRETE BY USING OPTICAL FIBER

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Abstract - *Translucent concrete is a composite material consisting of optical fibers, fine aggregate, ordinary Portland cement and water. It is different from conventional concrete as it contains no coarse aggregates. To evaluate the effectiveness of the smart translucent concrete, the present study aims at producing the concrete specimens by using optical fibers and comparing it with the normal cement concrete. Various tests are done to determine the strength characteristics, light transmittance and cost comparisons. One of the major advantages of this concrete is that it is eco-friendly, aesthetic and saves energy too*.

Key Words: Translucent concrete, optical fiber and wooden molds.

1. INTRODUCTION

A Translucent Concrete-construction material was assembled with Optical Fiber by drilling through the cement and fine aggregate in order to utilize the light guiding ability of Optical Fiber. The main purpose is to reduce the power consumption of illumination by using sunlight as a light source. Experiments to study the mechanical performance of the concrete inspired with Optical Fiber were carried out. Translucent concrete (Transparent concrete) is the Light Transmitting Concrete (LiTraCon) is new technique different from normal concrete. It provides pleasing aesthetics & looks. It is the "union of optical fibers and fine concrete". Translucent concrete gives great light and less weight compared to normal concrete. My project on TSC can reduce the operating energy requirement. The main purpose of translucent concrete is the use of sunlight source for light instead of using electrical energy, so it can reduce the load on non- renewable sources and result it into the energy saving with natural lighting.

1.1 Aim of the project

- To the use of sunlight source of light instead of using electrical energy by translucent concrete.
- So as to reduce the load on non-renewable sources and result it in to the energy saving.

2. PREPARATION OF TRANSLUCENT CONCRETE

Translucent concrete is assemble by integrating of two considerable materials; fine concrete (with cement and aggregates like sand) and optical fibers.

2.1 Preparation of mold

Panel molds are made up of four plywood faces, in which two faces having Thickness 5mm with wooden base plate. The two faces of plywood are undrilled and remaining two faces of plywood are drilled as per the following pattern. Holes are drilled in the faces having thickness 5 mm. Drilled and undrilled plywood plates are attach with each other. Two drilled plywood faces are placed opposite to each other so as to orient the optical fibers in a single direction.

Figure-1: Mold with drilled holes

2.2 Arrangement of optical fibers

The procedure of translucent concrete is almost same as regular concrete. Only difference is that optical fibers are spread throughout the aggregate and cement mix. Light transmitting concrete is produced by adding 4% to 5% optical fibers by volume into the concrete mixture. Here adding 4% optical fibers by volume into the fine aggregate and cement mix. Thickness of the optical fibers can be varied between 2 μm and 2 mm to suit the particular needs of light transmission. Here 1 mm diameter optical fibers were used. After oiling the mold, optical fibers were tied at one end, inserted through the drilled holes, and stretched at other end.

Figure-2: Arrangement of optical fibers

2.3 Pouring the concrete

Mixing method was adopted throughout the experiment. It was always ensured that proper and uniform mixing of the concrete was obtained. Finally, water is added and concrete is mixed until it appears to be homogeneous and of the desired consistency.

The concrete mixture produce from fine materials only it does not contain coarse aggregate. Poured the prepared mix carefully and slowly in fiber placed mold. The specimens were prepared by compacting the concrete in three layers. Table vibrator was used for contraction of concrete. After completion of contraction, excess material was take out and the mold was leveled by using a travel.

Figure-3: Stages of Pouring the Concrete

2.4 De-molding and polishing

The cast molds were kept undisturbed on the leveled platform. Then it was de-molded carefully after 24 hours, from casting. It is then polished their surfaces well by using sand papers. After that the specimens were marked by their respective identification marks.

Figure-4: Specimen after de-molding and polishing

2.5 Curing

Curing is the process of preventing the loss of moisture from concrete while keeping a satisfactory temperature. More explicate curing is defined as process of keeping satisfactory moisture content and commendatory temperature in concrete during the phase immediately following placement, so as hydration of cement may continue until the desire properties are expanding to a sufficient degree to meet the demand at the service. After polishing, the specimens immediately submerged in clean and fresh water for 28 days in the present work.

3. TESTS ON TRANSLUCENT CONCRETE

The tests conducted to this are compressive strength test and light transmission test. The material used for this concrete are cement (53 grade), sand (2.36 mm sieve passing), optical fiber cables 200 micron diameter.

3.1 Light transmitting test

The light transmittance through the sample can be measured by measuring the current corresponding to the light which can be measured by a Nvis 6023 Malus Law Apparatus. This apparatus dedicated to elucidate students to understand the wave nature of light. LED is used as an un-polarized light. With the help of this apparatus the basic law of polarization, Brewster's law, and Malus law experiment can be verified. In this study we used it for measuring the current passing only. Variation of intensity shown in the digital ammeter connected across photo detector. Nvis 6023 Malus Law

Apparatus is an ideal platform to enhance education, training, skills and development among our young minds. Test was conducted on panel specimens.

Light transmittance = 100 –[(A1–A2)/A1 x100]

Where;

A1 = Light transmitted without sample

A2 = Light transmitted with sample

Figure-5: Light transmitting test in day light

Table -1: Results of light transmitting test in day light

Sl No.	Micro ammeter Reading		Light Transmittance (%)	Mean Light Transmittance (%)
	Without Sample (A1)	With Sample (A2)		
1	1020	202	19.8	18.43
2	1020	188	18.43	
3	1020	174	17.05	

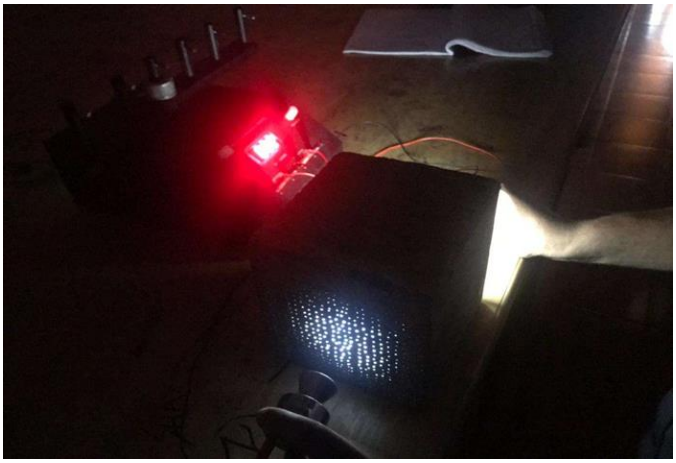


Figure-6: Light transmitting test in dark room

Sl. No.	Micro ammeter Reading		Light Transmittance (%)	Mean Light Transmittance (%)
	Without Sample (A1)	With Sample (A2)		
1	1017	285	28.02	26.87
2	1017	272	26.74	
3	1017	263	25.86	

Table -2: Results of light transmitting test in dark room

3.2 Compressive strength test

Test was conducted as per IS 516-1959. The panels of standard size were used to find out the compressive strength of translucent concrete. After 28 days of curing period, the specimens were taken out and allowed to dry for about four hours. After that specimens were placed in manner that the optical fibers are perpendicular to the loading point on the bearing surface of UTM of capacity 100 tones without eccentricity and a uniform rate of loading of 550 Kg/cm2 per minute was put it up to crack on the cube. The maximum load was noted and the compressive strength of was calculated.

Table -3: Compressive strength on TSC

Specimen	P (N)	A (mm^2)	Compressive Strength (N/mm^2)
1	$640X10^3$	22500	28.4
2	$600X10^3$	22500	26.7
3	$590X10^3$	22500	26.2

Therefore, mean compressive strength of TSC= 27.1 N/mm^2

3.3 Split tensile strength test

This is also referred to "Brazilian Test". Test conducted after 28 days of curing period, specimen is placed horizontally between the loading surface of a compression testing machine and load is applied until the failure of the cylinder, along the vertical diameter. When the load is applied along the vertical axis of the specimen is subjected to a horizontal stress of F/A. Where,

F = Compressive load on the specimen

A = Area of the specimen

Table -4: Split tensile strength test on TSC

Specimen	P (N)	Split Tensile Strength (N/Mm2)
1	169X103	2.391
2	180X103	2.546
3	212X103	2.999

Therefore, mean split tensile strength of TSC = 2.65 N/mm2.

4. COMPARISSON STUDIES

4.1 Comparison of compressive strength

Table -5: Compressive strength comparison of NCC and TSC

Sl. No	Compressive Strength in N/mm^2		Increase in Compressive Strength (%)
	NCC	TSC	
1	24.8	27.1	9.27

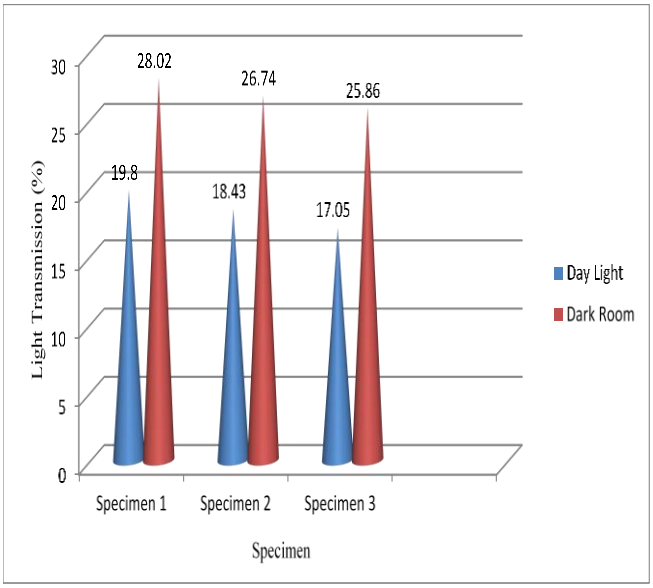
The compressive strength test results of the translucent concrete with respective to the normal concrete was observed that all the translucent concrete specimens carried a compressive strength higher than that of the normal concrete.

4.2 Comparison of split tensile strength

Table -6: Split tensile strength comparison of NCC and TSC

Sl. No	Split Tensile Strength in N/mm^2		Decrease in Split Tensile Strength (%)
	NCC	TSC	
1	3.5	2.65	32.1

4.3 Comparison of light transmission in day light and dark room



Graph -1: Variations in light transmittance

5. DISCUSSIONS

- For the optimal percentage of optical fiber induced concrete, about 18.43 % of light was passed through the specimen in day light and about 26.89 % of light was passed through the specimen in dark room.
- Compressive strength of TSC was higher than the NCC. For NCC it was 24.8 N/mm^2, but for TSC it was 27.1 N/mm^2. Which may due to the reinforcement of optical fiber.
- Split tensile strength of NCC was 3.5 N/mm^2 and for TSC, it was 2.65 N/mm^2. Which is slightly lesser than NCC.
- Initial high cost is major problem of TSC.

6. CONCLUSIONS

Translucent concrete panels can be used in many ways and executive into many structure and be highly advantageous. Still, the only feedback would be its extravagant. Hence it not include on high class architects from using it. It is considerable as sign of attraction and artistic growth. With the optimal percentage of optical fiber, that is 4% concrete has slightly higher strength than the conventional concrete. And has the ability to transmit light, there by changes the image of conventional concrete. Only fine aggregates are used because if we use coarse aggregates it may damage the optical fibers and change their properties.

Transparent concrete structures acceptable for load bearing walls, floors and pavements. In furniture for the embellishing and aesthetic purpose.

Translucent concrete blocks used as Partitions wall, where the sunlight does not reach properly. The reason for higher cost is that optical fiber is not locally available in our country in the desired rates. Hence the deep construction is not suitable by translucent concrete, but the small constructions like partitions wall are more suitable and benefit by translucent concrete.

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