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AN EXPERIMENTAL STUDY ON TRANSLUCENT LIGHTWEIGHT CONCRETE

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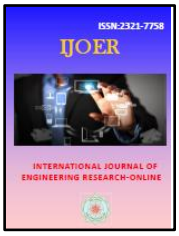

ABSTRACT

Translucent lightweight Concrete is a new material with various applications in the construction field, architecture, decoration and even furniture. As can be imagined, concrete with the characteristic of being translucent will permit a better interaction between the construction and its environment, thereby creating ambiences that are better and more naturally lit, at the same time as significantly reducing the expenses of laying and maintenance of the concrete. Thousands of optical filaments are arranged side by side on a concrete base leaving the light to pass from one side to the other. Due to the small thickness of these filaments, they combine with the concrete. Compared with a traditional electric lighting system, illuminating the indoors with daylight also creates a more appealing and healthy environment for building occupants. Translucent concrete is a combination of optical fibres and fine concrete, combined in such a way that the material was both internally and externally homogeneous. It was manufactured in blocks and used primarily for decoration. LiTraCon (Light Transmitting Concrete) presents the concept of light transmitting concrete in the form of a widely applicable new building material. It can be used for interior or exterior walls, illuminated pavements or even in art or design objects.

INTRODUCTION

Translucent lightweight Concrete is a new material with various applications in the construction field, architecture, decoration and even furniture. As can be imagined, concrete with the characteristic of being translucent will permit a better interaction between the construction and its environment, thereby creating ambiences that are better and more naturally lit, at the same time as significantly reducing the expenses of laying and maintenance of the concrete. Thousands of optical filaments are arranged side by side on a concrete base leaving the light to pass from one side to the other. Due to the small thickness of these filaments, they combine with the concrete. Compared with a traditional electric lighting system, illuminating the indoors with daylight also creates a more appealing and healthy environment for building occupants. Translucent concrete is a combination of optical fibers and fine concrete, combined in such a way that the material was both internally and externally homogeneous. It was manufactured in blocks and used primarily for decoration. LiTraCon (Light Transmitting Concrete) presents the concept of light transmitting concrete in the form of a widely applicable new building material. It can be used for interior or exterior walls, illuminated pavements or even in art or design objects.

Major objective of this project is to study fresh and hardened properties of normal translucent concrete and light weight translucent concrete. It includes,

- The study of workability of the concrete
- The determination of compressive strength of normal and light weight translucent concrete
- The determination of flexural strength
- The check for light transmittance
- In the current scenario, energy efficient building materials and concepts have been attracted much attention by the engineers. In this project we mainly focus on reducing the dead weight of structures and reduces amount of sand.
- Future scope of this topic includes development of a high strength light weight translucent concrete, replacement of cement and aggregates with other efficient materials.
- The main purpose translucent concrete 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. These properties can be improved by using high quality fibers to make them economical new low cost manufacturing methods should developed. Another approach is made to replace the traditional concrete materials, gravel, sand and cement with plastics and glass of various sizes and bind them together with transparent glue which having more scope in the manufacturing of transparent panels.
- In practical uses this technology has more scope such as, making glowing sidewalks, and speed bumps for drivers at night and it can be used for Light fixtures by increasing visibility in dark subway stations, lighting indoor fire escapes in the event of a power failure, etc.
- In order for this concrete to be a viable construction material, it must be able to compete economically with existing light transmitting concrete materials. This project deals specifically with the concrete embedded by the low cost plastic optic fibres and waste coir pith.

MATERIALS AND METHOD

The materials used for the making of light weight translucent are,

1. Cement (OPC grade 53)
2. Plastic optical fibre
3. Fine Aggregate
4. Coarse Aggregate
5. Coir Pith
6. Water

Cement, coarse aggregate and fine aggregate are as per IS recommendations

Optical Fiber

There are two types of fibre optics they are plastic fibre optics and glass fibre optics. But we used plastic optic fibres (POF), because of low cost and economy. It is an optical fibre which is made out of plastic. The core material is acrylic, and fluorinated polymers are the cladding material. Almost 96% of the cross section is the core of fibre that allows the transmission of light. As same as traditional glass fibre, that transmits light (or data) through the core of the fibre. The core size is 100 times larger in plastic fibre optics compared to than glass fibe. Optical fibers passes as much light when tiny slits are placed directly on top of each other as when they are staggered. Principal can carry because optical fibres in the concrete act like the slits and carry the light across throughout the concrete. The weight optical fibre used in this project is 4% of the weight of cement.

Coir pith

Coir pith is a byproduct of the coir industry, producing more than 7.5 million tonnes annually in India. This study investigates different physical properties of coir pith with respect to its moisture content (10.1 to 60.2%w.b.) and particle size (0.098 to 0.925mm). Porosity and particle density varied from 0.623 to 0.862 and from 0.939 to 0.605 gm/cc respectively. Bulk density is in the range of 0.097 to 0.341gm/cc.

M20 mix is designed after testing of cement and aggregates. Then prepared 3 samples with one translucent concrete sample and mix with coir pith 5%,15%and 25% for both compressive strength and flexural strength tests

RESULTS AND DISCUSSIONS

SLUMP TEST

Slump test is conducted to determine the workability of each mix. The test is conducted using standard sized slump cone and by following procedure of the test. Values of slump obtained for each mix are tabulated below.

Table 3.1 Slump test

Concrete Mix	Slump (mm)	Degree of workability
Normal translucent concrete	52	Low
Mix with 5% coir pith	48	Low
Mix with 15% coir pith	41	Low
Mix with 25% coir pith	36	Low

COMPRESSIVE STRENGTH

Compression test is the most common test conducted on hardened concrete, because it is easy to perform and most of the desirable characteristic properties of concrete are qualitatively related to its compressive strength. The cubes of size 10 cm x 10 cm x 10 cm were casted. The compressive strength of the cubes was tested on compression testing machine. The compressive strength of the normal translucent and light weight translucent concrete are tabulated below. Three cubes were casted from a single mix and is tested to find the compressive strength. The average of three results was taken as the final answer.

$$\text{Compressive strength of concrete} = \frac{\text{Applied load}}{\text{Cross sectional area of cube}}$$

Compressive strengths of cubes of normal translucent concrete after 28 days are tabulated below.

Table 3.2 Compressive Strength of normal translucent concrete at 28 days

TESTED AFTER	CUBE NO:	MAXIMUM LOAD (kN)	COMPRESSIVE STRENGTH (N/mm^2)
28 Days	1	446	44.6
	2	282	28.2
	3	260	26

Table 3.3 Compressive Strength of light weight translucent concrete with 5% coir pith at 28 days

TESTED AFTER	CUBE NO:	MAXIMUM LOAD (kN)	COMPRESSIVE STRENGTH (N/mm^2)
28 Days	1	334	33.4
	2	304	30.4
	3	290	29

Table 3.4 Compressive Strength of light weight translucent concrete with 15% coir pith at 28 days

TESTED AFTER	CUBE NO:	MAXIMUM LOAD (kN)	COMPRESSIVE STRENGTH (N/mm^2)
28 Days	1	242	24.2
	2	224	22.4
	3	248	24.8

Table 3.5 Compressive Strength of light weight translucent concrete with 25% coir pith at 28 days

TESTED AFTER	CUBE NO:	MAXIMUM LOAD (kN)	COMPRESSIVE STRENGTH (N/mm^2)
28 Days	1	150	15
	2	176	17.6
	3	184	18.4

Table 3.6 Compressive Strength of normal and light weight translucent concrete at 28 days

Item	Compressive strength (N/mm^2)		
Normal Translucent Concrete	32.93 % Replacement		
Light weight Translucent concrete	5%	15%	25%
	30.93	23.8	17

6.3 FLEXURAL SRENGTH

The flexural strength of the beams was also determined. The beams of size 100 mm x 100 mm x 500 mm were casted. Three beams were tested and the average was taken as the result. The flexural strength of the specimen is expressed as the modulus of rupture F_b which,if 'a' equals the distance between the line of fracture and the nearer support, measured on the center line of the tensile side of the specimen in cm

Table 3.7 Flexural Strength of normal translucent concrete at 28 days

TESTED AFTER	BEAM NO:	MAXIMUM LOAD (kN)	FLEXURAL STRENGTH (N/mm^2)
28 DAYS	1	13.5	5.4
	2	12.8	5.12
	3	12.2	4.88

Table 3.8 Flexural Strength of light weight translucent concrete with 5% coir pith at 28 days

TESTED AFTER	BEAM NO:	MAXIMUM LOAD (kN)	FLEXURAL STRENGTH (N/mm^2)
28 DAYS	1	10.5	4.20
	2	11.2	4.48
	3	9.8	3.92

Table 3.9 Flexural Strength of light weight translucent concrete with 15% coir pith at 28 days

TESTED AFTER	BEAM NO:	MAXIMUM LOAD (kN)	FLEXURAL STRENGTH (N/mm^2)
28 DAYS	1	9.5	3.80
	2	10.6	4.24
	3	10.1	4.04

Table 3.10 Flexural Strength of light weight translucent concrete with 25% coir pith at 28 days

TESTED AFTER	BEAM NO:	MAXIMUM LOAD (kN)	FLEXURAL STRENGTH (N/mm^5)
28 DAYS	1	6.5	2.6
	2	7.3	2.92
	3	7.0	2.8

Table 3.11

Item	Flexural strength (N/mm^2)		
Normal Translucent Concrete	5.13		
	% Replacement		
Light weight Translucent concrete	5%	15%	25%
	4.2	4.03	2.77

LIGHT TRANSMITTANCE TEST

Light transmittance test can be done using various light measuring equipments such as Lux meter, however, a simple Lux meter can be made in a laboratory using simple components. The light transmittance through the sample can be measured by measuring the current corresponding to the light which can be measured by a photo diode or a Light Dependent Resistors (LDR). The use of photo diode would require a separate sensor which would increase the cost of the project. The most apt choice would be LDR

Table 3.12 Test results for light transmission

Input voltage (V)	Output		
	Without specimen (mA)	With specimen(mA)	Light (%)
50	4	2	50
100	10	3	30
150	24	4	16.66
200	36	6	16.66
220	44	8	18.88

WEIGHT OF SPECIMEN

Test has been done to measure the weight of specimen so as to check if the specimen made is light weight. Observations and results are tabulated below.

Table 6.13Weight of specimens

Item	Weight of specimen (kg)		
Normal Translucent Concrete	Cube	2.45	
	Beam	12.97	
Light weight Translucent concrete	% Replacement		
	5%	15%	25%
Cube	2.36	2.23	2.03
Beam	12.36	11.74	11.06

CONCLUSIONS

The translucent concrete prepared shows good light transmittance, the main advantage of using translucent concrete is that increment in the strength properties along with the natural light transmission. Following conclusions are obtained.

1. The compressive strength of the normal translucent concrete, at 28 days age, is found to be 32.93 N/mm^2.
2. The compressive strength of light weight translucent concrete is found to be decreasing as the % replacement of fine aggregate with coir pith increases and the satisfactory results are obtained upto 15% replacement.
3. The flexural strength of normal translucent concrete at 28 days age is 5.13 N/mm^2.
4. The flexural strength of light weight translucent concrete is found to be decreasing as the % replacement of fine aggregate with coir pith increases and the satisfactory results are obtained upto 15% replacement.
5. The compressive strength and flexural strength was found to be considerably decreasing in between 15% and 25%, so further replacement is not suggested.
6. The weight of concrete is reduced by 17% at 25% replacement of fine aggregate with coir pith but the compressive and flexural strength of concrete are found to decreasing considerably after 15% replacement.
7. Translucent concrete showed good light transmitting propert
8. The compressive strength of the normal translucent concrete, at 28 days age, is found to be 32.93 N/mm^2.
9. The compressive strength of light weight translucent concrete is found to be decreasing as the % replacement of fine aggregate with coir pith increases and the satisfactory results are obtained upto 15% replacement.
10. The flexural strength of normal translucent concrete at 28 days age is 5.13 N/mm^2.
11. The flexural strength of light weight translucent concrete is found to be decreasing as the % replacement of fine aggregate with coir pith increases and the satisfactory results are obtained upto 15% replacement.
12. The compressive strength and flexural strength was found to be considerably decreasing in between 15% and 25%, so further replacement is not suggested.
13. The weight of concrete is reduced by 17% at 25% replacement of fine aggregate with coir pith but the compressive and flexural strength of concrete are found to decreasing considerably after 15% replacement.
14. Translucent concrete showed good light transmitting property.

The results evidently show that the weight of the translucent concrete was successfully decreased by the replacement of fine aggregate with coir pith without affecting its strength and light transmitting property

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