Experimental Study on Light Transmitting Concrete

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Abstract

Light transmitting concrete allows light to pass through it because of the presence of optical fibers within the opaque concrete wall. The objective of this project is to make transparent concrete blocks with the use of optical fibers. Compressive tests further carried on our conventional concrete samples and different trial 1 %, 2 %, 3 %, 4 % and 5 % optical fibers in conventional concrete with addition of 1.5 % GI fibers. A very small percentage of plastic optical fibers of 4 % of surface area, transmit a light intensity worth of 45.3% at a distance of 15 cm from the face of wall. As percentage of optical fiber increases, the compressive strength of concrete decreases. While add 1.5% of GI fibers in concrete result increased in compressive strength in LTC.

Keywords: Optical fibers, masonry blocks, light transmitting concrete (LTC)

I. INTRODUCTION

Infrastructure development is always indicative of the development of a country. Rapid urbanization has led to the development of innovative materials and technology for construction. Alarming depletion of natural resourced has necessitated the need to develop materials and methods which promise sustainable / green construction.

Today we are living in a world where energy expenditure and environmental problems have escalated to global scale. Our built environment takes energy to make the materials that go into the buildings, utilize energy to construct them (embodied energy) as well as heat, cool & light constructed structures (operating energy). The concept of light transmitting concrete has been materialized previously in the form of a commercial product, LitraCon by Hungarian architect, Aron Losonczi. Added feature is its pleasing aesthetics that can change the image of the concrete which is generally perceived as dull, pale and opaque grey material.

Fig. 1.1: LitraCon products (a) Litracon PXL- prefabricated panels; (b) Litracube Lamp

The galvanized iron fibre of 1mm diameter is used in concrete mix. The length of the fibre is kept as 15mm. The aspect ratio of the fibre is 15. The fibre is added in concrete in different volume fraction like 0%, 0.5%, 1.0%, 1.5% and 2.0%. Density of the GI fibre is 7850 kg/m^3[8].

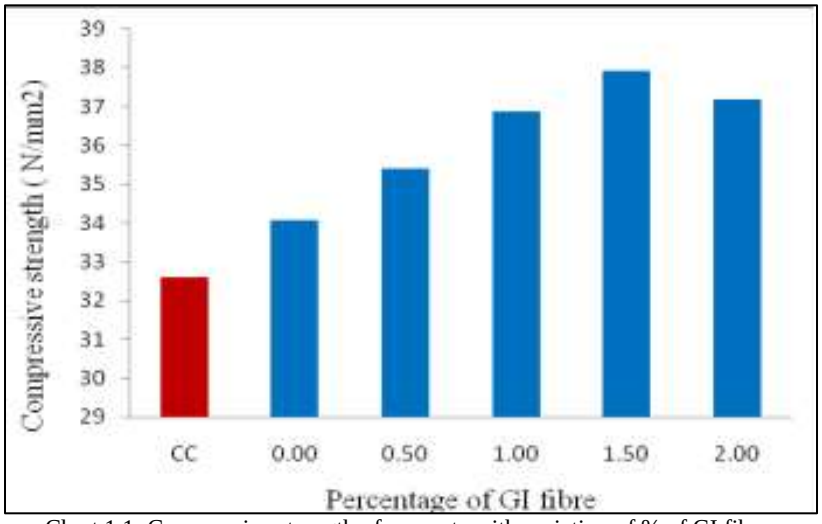

Chart 1.1: Compressive strength of concrete with variation of % of GI fibers

II. OBJECTIVES

The main objective is to increase the light transmitting property of concrete, and intensity of light emitting from the concrete. The following parameters which are consider for this work.

- To arrive at optimum water cement ratio in the manufacture of the light transmitting blocks so as to ensure a good workability for the mix.
- To find the compressive strength conventional concrete. with optimum percentage of G I fibers.
- To quantify the natural sunlight transmitted by these blocks when placed in a dark room in terms of lumens or voltage.
- To quantify the losses in light transmission with thickness of the Concrete.

III. TEST ON MATERIALS

A. Cement

Table - 3.1
The Physical Properties of Cement

Sl No	*Property*	*Results Obtained*	*Specification as per IS–Code*
1	*Normal consistency, %*	*31%*	*26-33%*
2	*Initial setting time, min*	*60*	*should not be less than 30mins*
3	*Specific gravity*	*3.1*	*3.15*

B. Fine Aggregate

Table - 3.2
Presents the physical properties of Sand

Sl No	*Property*	*Results Obtained*	*Specification as per IS–Code*
1	*Water content corresponding to maximum bulking, %*	*4*	
2	*Fineness Modulus of M-Sand*	*2.6*	*2.4-3.1*
3	*Specific gravity*	*2.535*	*2.65-2.7*

IV. RESULTS AND DISCUSSION

A. Compressive Strength

Compressive strength is basically done to find the compressive strength of the concrete or cement mortar. The main objective of compression test is to find out the amount of compressive stress the specimen can withstand. Or in other words, to know how much is the maximum load the specimen can take under compression.

Fig. 4.1: compressive testing machines

Table - 4.1
Compressive strength of conventional concrete.

Sl.no.	*No of days*	*Compressive strength*
1	*3 days*	*13.78 N/mm²*
2	*7 days*	*16.68 N/mm²*
3	*28 days*	*22.51 N/mm²*

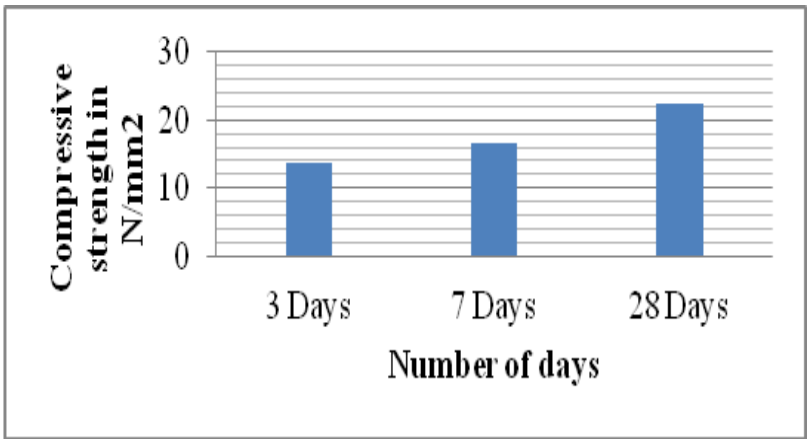

Chart 4.1: Relation between compressive strength and no. of days for conventional concrete

The strength of the conventional concrete will increase with the number of days .Thus compressive strength is directly propositional to no. of days.

B. Conventional Concrete with 1.5% GI fiber

Table - 4.2
Presents the compressive strength of conventional concrete with 1.5% of GI fiber.

Sl.no.	*No of days*	*Compressive strength*
1	*3 days*	*18.16 N/mm²*
2	*7 days*	*20.97 N/mm²*
3	*28 days*	*28.3 N/mm²*

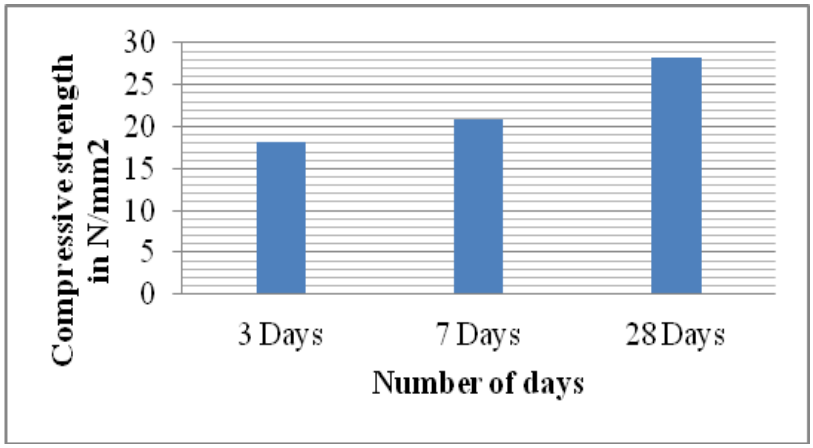

Chart 4.2: Relation between compressive strength and no. of days for conventional concrete with 1.5% GI fiber

The strength of the conventional concrete with 1.5% GI fiber will increase with the number of days. Thus compressive strength is directly propositional to no. of days.

C. *Light Transmitting Concrete in Addition with 1.5% GI fiber*

Table - 4.3
Presents the compressive strength of Light Transmitting concrete in addition with 1.5% GI fiber

Sl.no.	*% Of optical fiber*	*3 Days Compressive strength*	*7 Days Compressive strength*	*28 Days Compressive strength*
1	*1 %*	*17.77 N/mm²*	*20.44 N/mm²*	*27.6 N/mm²*
2	*2 %*	*17.2 N/mm²*	*19.91 N/mm²*	*26.3 N/mm²*
3	*3 %*	*16.48 N/mm²*	*18.93 N/mm²*	*25.5 N/mm²*
4	*4 %*	*15.91 N/mm²*	*18.4 N/mm²*	*25.28 N/mm²*
5	*5 %*	*15.33 N/mm²*	*17.86 N/mm²*	*24.15 N/mm²*

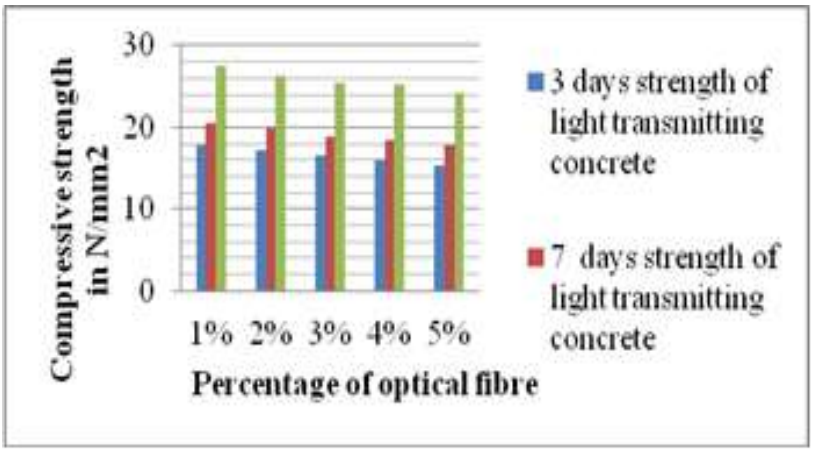

Chart 4.3: Relation between compressive strength and no. of days for light transmitting concrete.

While seeing above graph the frequently adding of plastic fiber there is a decrease in the strength of concrete

D. *Luminous intensity*

Table - 4.4
Presents the luminous intensity of Light Transmitting concrete.

Sl.no.	*% Of optical fiber*	*Without sample ammeter reading (A_1) in mA*	*With sample ammeter reading (A_2) in mA*	*Luminous intensity in % =100-((A_1-A_2)/A_1)x100*
1	*1 %*	*53.2*	*4.7*	*8.83*
2	*2 %*	*53.2*	*10.2*	*19.17*
3	*3 %*	*53.2*	*18.6*	*34.96*
4	*4 %*	*53.2*	*24.1*	*45.3*
5	*5 %*	*53.2*	*29.5*	*55.45*

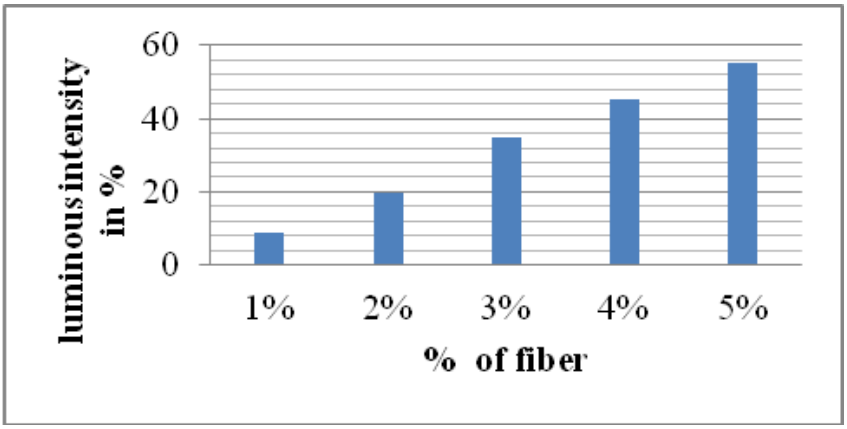

Chart 4.4: Relation between luminous intensity and % of fiber for light transmitting concrete

With the increase in the % of optical fiber there is increase in the luminous intensity of light transmitting concrete

E. Conventional Concrete and Conventional Concrete with Addition of 1.5% of GI fiber

Table - 4.5

Presents the Compression between conventional concrete and conventional concrete with addition of 1.5% of GI fiber

Sl.no.	*No of days*	*Conventional concrete*	*Conventional concrete with 1.5% GI fiber*
1	*3 days*	*13.78 N/mm^2*	*18.16 N/mm^2*
2	*7 days*	*16.68 N/mm^2*	*20.97 N/mm^2*
3	*28 days*	*22.51 N/mm^2*	*28.3 N/mm^2*

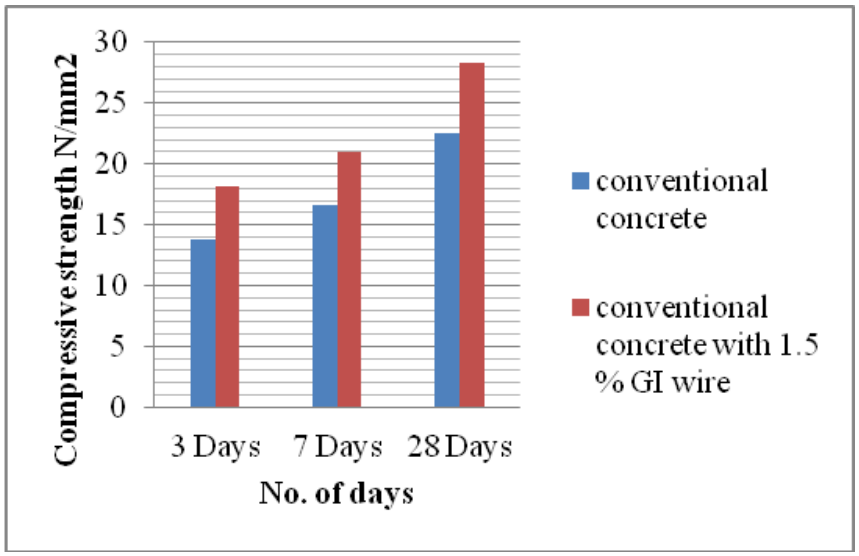

Chart 4.5: Comparasion between conventional concrete and conventional concrete with addition of 1.5% of GI fiber

The above graph shows the strength of conventional concrete with 1.5% GI fiber is approx 25% is more then the strength of conventional concrete

F. Conventional concrete with 1.5% GI fiber and light transmitting concrete in addition of 1.5% of GI fiber

Table - 4.6

Presents the Comparasion between conventional concrete with addition of 1.5% of GI fiber & and light transmitting concrete in addition of 1.5% of GI fiber.

Sl.no.	*Type of concrete*	*3 Days Compressive strength*	*7 Days Compressive strength*	*28 Days Compressive strength*
1	*Conventional concrete with 1.5% GI fiber*	*18.16 N/mm^2*	*20.97 N/mm^2*	*28.3 N/mm^2*
2	*1%*	*17.77 N/mm^2*	*20.44*	*27.6*
3	*2%*	*17.2 N/mm^2*	*19.91*	*26.3*
4	*3%*	*16.48 N/mm^2*	*18.93*	*25.5*

5	*4%*	*15.91 N/mm²*	*18.4*	*25.28*
6	*5%*	*15.33 N/mm²*	*17.86*	*24.15*

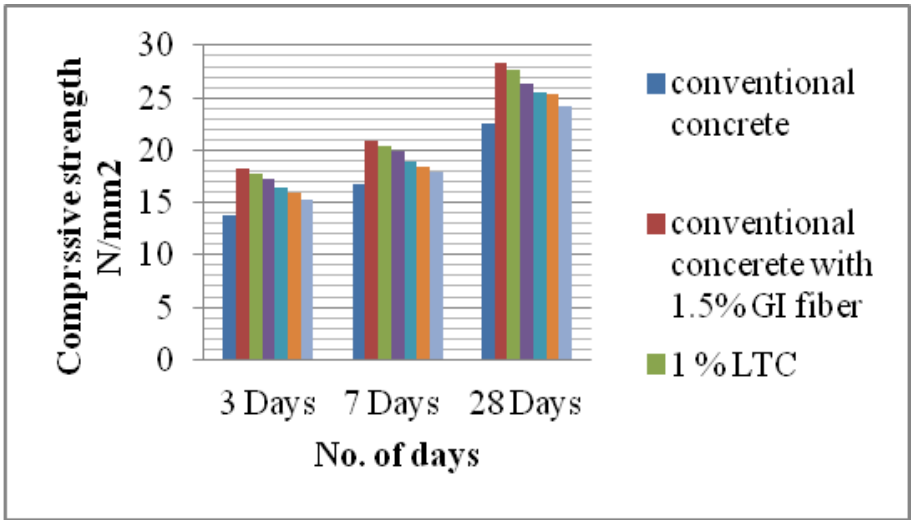

Chart 4.6: Comparasion between conventional concrete ,conventional concrete with addition of 1.5% of GI fiber & light transmitting concrete in addition of 1.5% of GI fiber

The fig shows the conventional concrete with 1.5%GI fiber strength is about 28.3N/mm2 for the 28 days. When frequently adding of plastic optical fiber to the conventional concrete with GI fiber the strength was slightly decress

G. *Conventional concrete, conventional concrete with addition of 1.5% of GI fiber and light transmitting concrete in addition of 1.5% of GI fiber.*

Table - 4.7

Presents the Comparasion between Conventional concrete, conventional concrete with addition of 1.5% of GI fiber and light transmitting concrete in addition of 1.5% of GI fiber.

Sl.no.	*Type of concrete*	*3 Days Compressive strength*	*7 Days Compressive strength*	*28 Days Compressive strength*
1	*Conventional concrete*	*13.78 N/mm²*	*16.68 N/mm²*	*22.51 N/mm²*
2	*Conventional concrete with 1.5% GI fiber*	*18.16 N/mm²*	*20.97 N/mm²*	*28.3 N/mm²*
3	*1%*	*17.77 N/mm²*	*20.44*	*27.6*
4	*2%*	*17.2 N/mm²*	*19.91*	*26.3*
5	*3%*	*16.48 N/mm²*	*18.93*	*25.5*
6	*4%*	*15.91 N/mm²*	*18.4*	*25.28*
7	*5%*	*15.33 N/mm²*	*17.86*	*24.15*

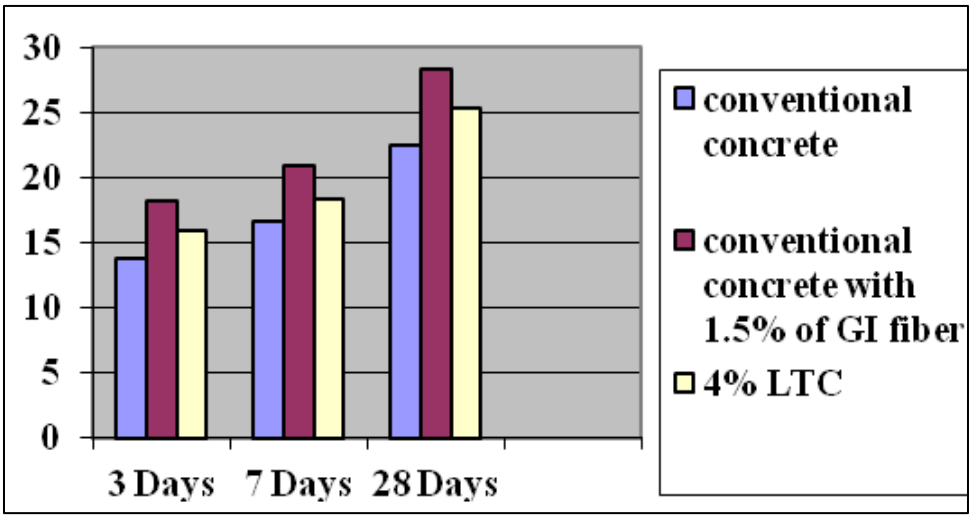

Chart 4.7: Comparasion between Conventional concrete, conventional concrete with addition of 1.5% of GI fiber and light transmitting concrete in addition of 1.5% of GI fiber.

By the result it may be concluded that the strength parameter of light transmitting concrete gose on decress without addition of optimum % of GI fiber of about 1.5% when compare to conventional concrete.

V. CONCLUSION

- It's a green building material reducing the lightning cost during day time.
- It's proved to provide both aesthetic appearance and structural stability. Light transmitting concrete is an emerging trend in concrete technology.
- From the experimental studies it is observed that a very small percentage of optical fibers, say 4% of surface area, transmits a light intensity worth 45.3% at a distance of 15 cm from the face of a wall.
- These blocks being made of cement mortar do not appear to be a prospective material for non-load bearing walls. Hence possibility of using these materials along with stabilised mud blocks needs to be investigated to ensure sustainability in construction.
- The reduction in the strength of light transmitting concrete with plastic optical fiber and without any other additional fibers can be overcomed by the addition of 1.5% GI fiber.

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