COMPARATIVE STUDY ON TRANSPARENT CONCRETE WITH 1% AND 3% POF

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ABSTRACT

This study mainly involves the light transmission and also the strength parameters of a latest technology called Transparent concrete which transforms the interior appearance of concrete buildings by making them feel light and well-ventilated rather than dark and heavy. Transparent Concrete is a type of concrete in which light transmitting Plastic Optical Fiber (POF) is arranged in an order which passes through fine concrete. It can be produced as prefabricated building blocks and panels. As the POF is smaller in size, they blend into concrete tends to act like the pieces of aggregate. In this manner, the result is not only two materials - glass in concrete - mixed, but a third, new material, which is homogeneous in its inner structure and on its main surfaces as well.

Keywords: *POF, LDR, Compression test, Flexural test*

INTRODUCTION

The aim of this paper is to investigate and describe one in all the actual forms of fine arts concrete – semitransparent concrete. This material is changing into a lot of common because of its uncommon properties. Its high strength and clear character are connected with aesthetic worth of concrete. Many samples of applications of this material are shown within the paper. The origin properties of this material are broadly represented in this paper. Architects categorical each feelings and emotions through their comes. Design is actually one in all the oldest forms of art departments. Since individuals left caves, they need started building shelters. Afterward they began to require care of look of their places of living, remodeling normal buildings into works of art. Construction technologies and building materials are developing for a really very long time and extremely quickly. A construction material that is consistently being changed so as to enhance its properties is concrete.

Concrete is being used since Roman times for the development of infrastructure and housing, but its basic components have remained the same. Three ingredients make up the dry mix: coarse aggregate, consisting of larger pieces of material like stones or gravel; fine aggregate, made up of smaller particles such as sand; and cement, a very fine powder material that binds the mix together when water is added.

But now in this experimental study, the major constituent of the concrete which is a Coarse aggregate is just neglected and is replaced with a bunch of POF arranged at a distance of 1.5 cm between the each fiber. In turn, the POF will acts a vital role not only in light transmission point of view, but also in strength parameter also.

The transparent concrete largely focuses on transparency and its objective of application pertains to green technology and artistic finish. It is the "combination of optical fibers and fine concrete". At present, most of the commercial structures focus greatly on saving energy with indoor thermal systems. so it's imperative to develop a replacement purposeful material to satisfy the structure in terms of safety observation (such as harm detection, fire warning), environmental protection and energy saving and creative modeling.
Due to economic process and construction of high-rise building, the space between buildings is reduced; this causes to increasing the utilization of non- renewable energy sources, thus thus there's a desire of sensible construction technique like inexperienced building and indoor thermal system.
Transparent concrete is new technique totally different from general concrete. Clear concrete permit additional lightweight compared to general concrete. The utilization of daylight supply of sunshine rather than using electricity is the main purpose of semitransparent concrete, therefore on scale back the load on non- renewable sources and result it into the energy saving. Optical fibers could be a sensing or transmission part; therefore decrease the utilization of artificial lightweight, the traditional concrete is replaced by semitransparent concrete that has natural lighting and art style.

LITERATURE REVIEW

M. Bill Price, et al (1999) studied many models but it is the first model. By his examination the light is passing through this concrete. His first trial considered all switching the different components of concrete to achieve transparency, without changing its basic composition. He used glass and plastic aggregates and he has developed several samples. We understand from the evaluations he is still working on his invention and adapting the mixes to several uses.

Aron Losonczi (2001) studied that Instead of making cement concrete itself translucent;they took an alternate track by joining straightforward materials into the solid. That Concrete modules contain glass optical filaments with thickness of a hair that transmit light from one side of the material to the next. Here we need to affirm that the finishes of every fiber reach the surfaces on the two sides of the material, the solid squares are worked in slender layers of cement filled a long, restricted form, and layers of optical filaments are laid along the length of the shape, exchanging cement and fiber. The subsequent long shaft is then stopped into, rectangular structure squares where differing the span of the squares, be that as it may, doesn't change the impact and the filaments transmit light the whole length.

Sergio Galvan (2007) examined definition utilizing a blend of polycarbonate and epoxy materials, just as glass strands, optical filaments, colloidal silica, silica, diethyletriamine (DETA) and Portland bond. Rock and sand are supplanted by pitches and strands. They guarantee the development has more noteworthy mechanical quality properties than those of a standard cement, with lower thickness and mechanical attributes that empower same to be utilized in both an auxiliary and engineering way, permitting qualities of 4500 kg/cm2, volumetric load of 2,000 kilograms for each cubic meter and that its last setting is under 7 days.

Jianping He et al (2011):The exploratory examination title was "C0ncentrate on Smart Transparent Concrete Product and Its Performances" ,procedures of The sixth International Workshop on Advanced Smart Materials and Smart Structures Technology ANCRISST2o11 July 25-26, 2011, Dalian, China, considered that the amazing properties of light controlling and elasto-optic impact of 0ptical fiber. The compressive quality of the relating concrete is genuinely impacted by measure of POFs. The POFs have diminished the c0unter penetrability of the solid.

Will Wittig, University of Detroit Mercy in Michigan(2011) considered the blended white silica sand, white Portland concrete and short strands of fiber glass to expand the quality of material. The last solid boards were meager as a coin at the focuses and near a centimeter thick at the corners. That the boards would be sufficiently translucent so that on a bright day, you could sit inside and have enough light to peruse a book, however his outcomes accomplished most slender sheets of the new concrete transmit around 1 percent of daylight, adequate light to inside the structure. From the Lab tests they demonstrated that the boards are not appropriate for wind and downpour.

J.Joao Manuel, et al (2013) examined the lightweight cement have significant highlights that make its utilization that including weight decrease, improved physical properties and their solidness. In the different sorts of lightweight cement the kind of lightweight total utilized fluctuates, similar to the extended granulated stopper, extended mud, pumice stone, polystyrene froth or EPS. A translucent lightweight concrete as development material, design material and material for furniture including and they accomplished utilizing stopper, fiber optics and uncommon mortar bond.

Basma F.Bashbash et al(2013): The investigation title for the project is “Basics of light Transmitting Concrete”, Global Advanced Research Journal of Engineering, Technology and Innovation (ISSN: 2315-5124) Vol. 2(3) pp. 076-083, March- 2013.

METHODOLOGY

1. At first, concrete moulds are prepared separately with different capable sizes which could be tested for determining different parameters.
2. The panel mould size should be maintained as 150mm x 50mm x 100mm which could be easier for light transmission test.
3. Thereafter, arrange the POF from the holes provided at a distance of 1.5 cm apart. See that the optical fiber is fixed tightly without getting over bends and also overlaps.
4. Now, prepare the cement and fine aggregate mix and pour into the POF arranged mould.
5. Apply required vibration to the mould so that the slurry does not get any void gaps in between.
6. Remove excess mix from the top of the mould and place it in undisturbed condition for a period of about 24 hours at a room temperature.
7. Remould the samples after 24 hours and keep those into a curing tank for the required number of days you wish to test the samples such as 7, 14 & 28 days.
8. Care must be taken while remoulding the samples as the POF will not cut in a easier manner.
9. Remove the samples from the curing tank after the curing period and set it dry.
10. Now, polish the surface of the sample slightly and the required tests are undergone.

Fig 1: Mould Diagram

Fig 2: Plastic Optical Fiber (1mm)

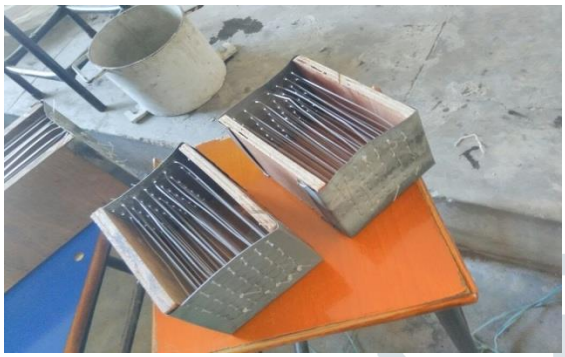


Fig 3: Fixing the POF

Fig 4: Concreting the Mould

EXPERIMENTAL INVESTIGATION

TESTS ON TRANSLUCENT CONCRETE

- LDR Test (Light transmission test)
- Compression strength test
- Flexural strength test

I. LIGHT TRANSMISSION TEST

- We have different light measuring apparatus in the lab and on the most important are lux meter; however, a simple Lux meter can be made in a laboratory using simple components.
- The light transmittance through the sample was evaluated by estimating the current relating to the light which can be estimated by a photo diode or a Light Dependent Resistors (LDR).
- The use of photo diode required a separate sensor which would increase the cost of the project.
- The most apt choice would be LDR. The LDR measures the light transmitted through the sample available and here after it will be converted into current, which is measured in mille Amperes (mA) as per the circuit diagram.
- 200 W incandescent bulbs is considered as source of light, a circuit was applied with 100 Ω of resistance and a DC voltage of 2.7 V was induced amongst the circuit.
- To determine the total light we use a plywood box. In this arrangement LDR is fixed in bottom and the source of light is in top.

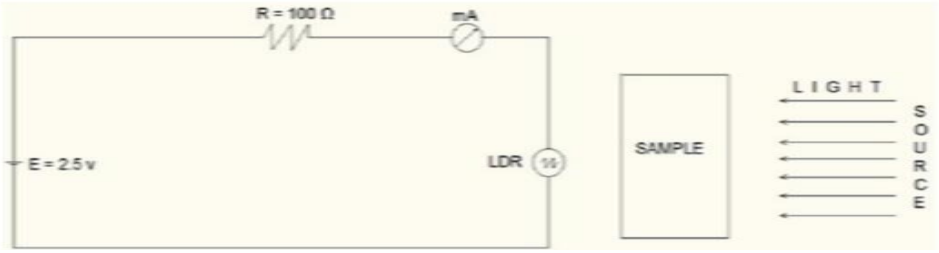


Fig. 5: Circuit Diagram

II. COMPRESSIVE STRENGTH TEST

The compressive strength is calculated by the value of compressive stress that is touched when the material fails completely. The compressive test is conducted for the knowing the compressive strength.

The mould dimensions of150mmx100mmx100mmaretakenfor the calculation of compressive strength of the given mould.

Compressive strength = load/area

For each set 2 standard cubes were cast to determine 7-days, and 28 days compressive strength after curing. Also two cubes were casted to know the compressive strength of concrete.

III. FLEXURAL STRENGTH TEST

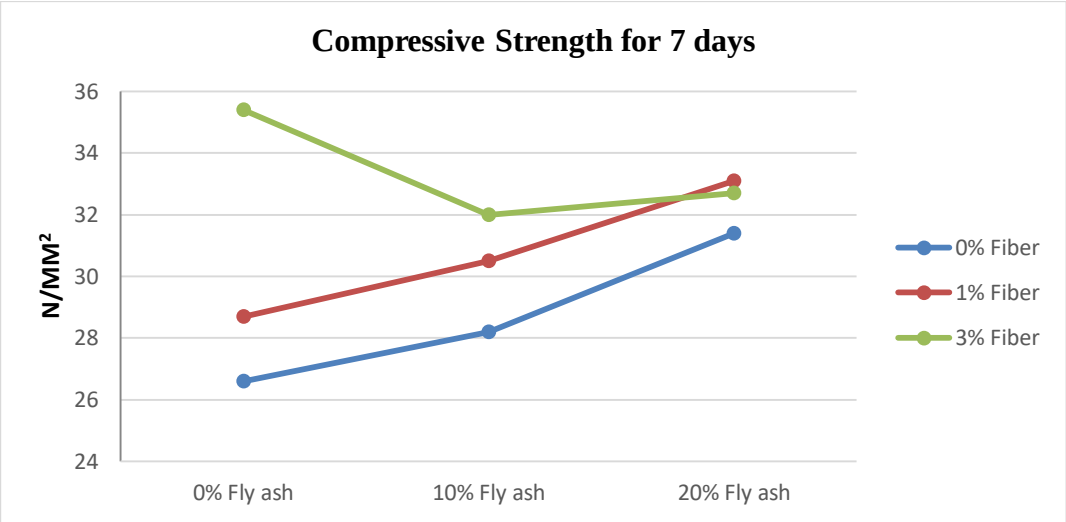
Flexural testing is employed to see the flex or bending properties of a mould. Typically named as a crosswise beam check, it involves putting a sample between 2 purposes or supports and initiating a load employing a third point or with 2 points that area unit severally decision 3-Point Bend and 4-Point Bend testing

TEST RESULTS

COMPARISON OF COMPRESSIVE STRENGTH RESULTS

Table 1: Comparison of compressive strength of Mortar for 7 days (N/mm^2)

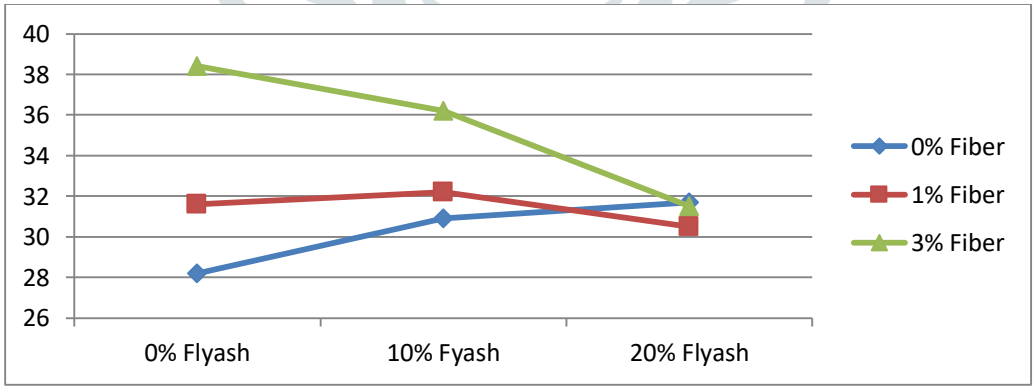
% of Fly ash	% of Fiber		
	0%	1%	3%
0%	26.6	28.7	35.4
10%	28.2	30.5	32.0
20%	31.4	33.1	32.7



Graph 1: Comparison of Compressive strength for 7days

Table 2: Comparison of compressive strength of Mortar for 28 days (N/mm^2)

% of Fly ash	% of Fiber		
	0%	1%	3%
0%	28.2	31.6	38.4
10%	30.9	32.2	36.2
20%	31.7	30.5	31.5



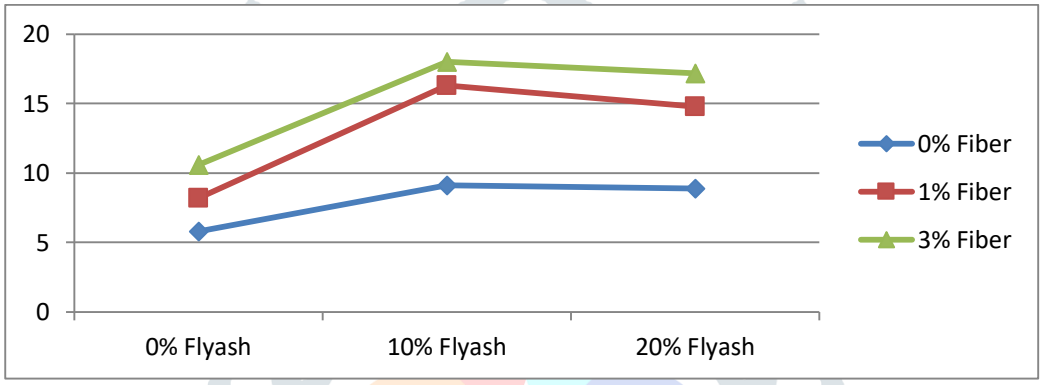
Graph 2: Comparison of compressive strength for 28 Days

COMPARISION OF FLEXURAL STRENGTH RESULTS:

The flexural strength parameters can be obtained as usual by taking the averages of the values

Table 3: Comparison of Flexural strength of Mortar for 7 days In (N/mm^2)

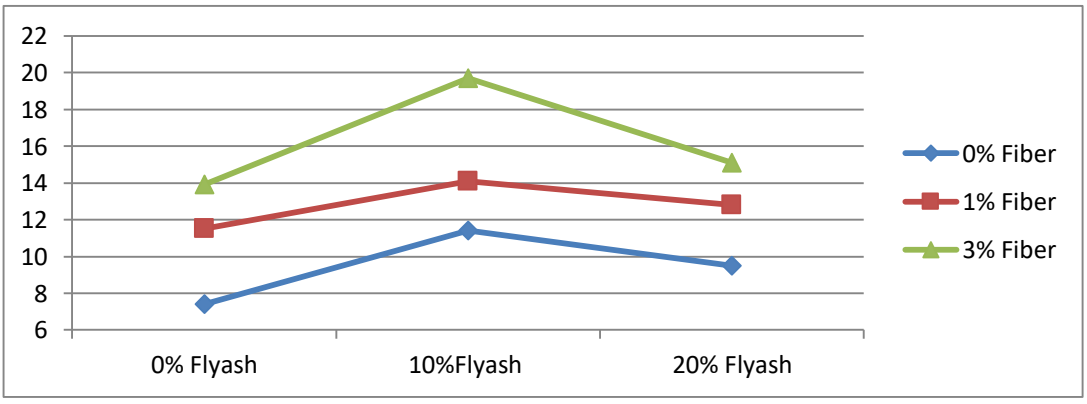
% of Fly ash	% of Fiber		
	0%	1%	3%
0%	5.8	8.2	10.6
10%	9.1	16.3	18.0
20%	8.9	14.8	17.2



Graph 3: Comparison of flexural strength for 7 Days

Table 4: Comparison of Flexural strength of Mortar for 28 days In (N/mm^2)

% of Fly ash	% of Fiber		
	0%	1%	3%
0%	7.4	11.5	13.9
10%	11.4	14.1	19.7
20%	9.5	12.8	15.1

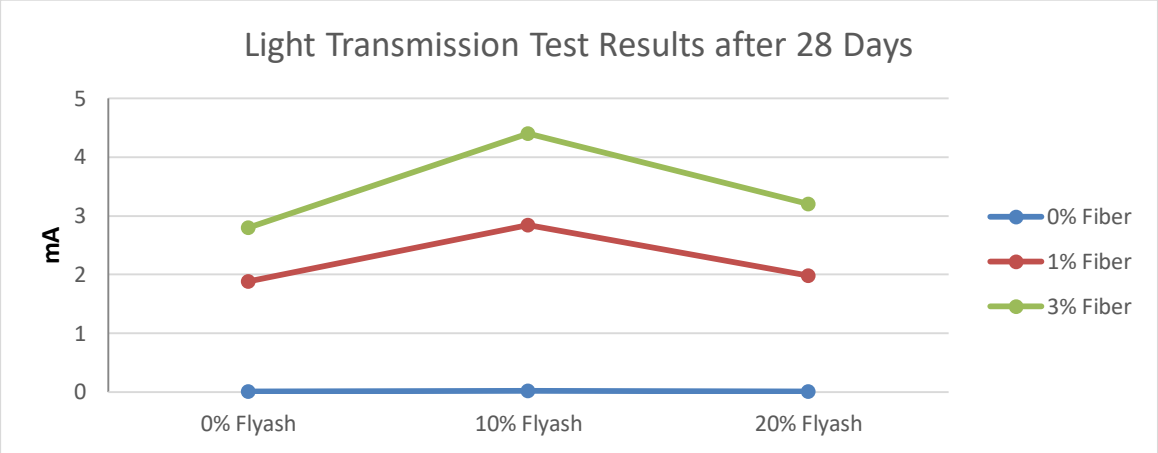


Graph 4: flexural strength for 28 days

COMPARISION OF LIGHT TRANSMISSION TEST RESULTS:

Table 5: Comparison of Light Transmission test of Mortar for 28 days in (mA)

% of Fly ash	% of Fiber		
	0%	1%	3%
0%	0.01	1.88	2.80
10%	0.02	2.84	4.40
20%	0.01	1.98	3.20



Graph 5: Light Transmission Test Results after 28 Days

DISCUSSION

Light Transmission Test after 28 Days:

- From the test results obtained for various percentages of Flyash, it is found that the sample containing 10% Flyash with 3% POF allows the light to a larger extent of about 4.40 mA.
- In general when the light transmission test was conducted with no sample, it was about 5.2 mA.
- Hence it can be concluded that the sample with 10% Flyash & 3% POF allows the light of about 84.6% through the Optical Fiber.

Compressive Strength Test after 7 Days:

- As per the test results obtained for 7 days curing, it is found from the table 1 that the sample containing 0% Flyash with 3% POF has comparatively higher value of about 35.4 N/mm^2.
- When compared with the original sample, the value of the above proportion has increased for about 8.8 MPa.

Compressive Strength Test after 28 Days:

- When the compressive strength values are compared after 28 days curing, it was found from the table 2 that the sample with 0% Flyash and 3% POF has got a higher value of about 38.4 N/mm^2.
- When compared with the original sample, the value of the above proportion has increased for about 10.2 MPa.

Flexural Strength Test after 7 Days:

- Flexural Strength of various samples with different proportions was tested after 7 days curing and was found that the sample containing 10% Flyash with 3% POF has got a higher value of about 18.0 N/mm^2.
- When compared with the original sample, the value of the above proportion has increased for about 12.2 MPa.

Flexural Strength Test after 28 Days:

- After the 28 days curing, various samples were tested and among those, it was found that the sample containing 10% Flyash with 3% POF has got a larger value of about 19.7 N/mm^2.
- When compared with the original sample, the value of the above proportion has increased for about 12.3 MPa.

CONCLUSIONS

Based on the experimental results on the light transmission, Compressive strength, flexural strength and considering the "environmental aspects" the following observations made regarding of POF and fly ash added concrete.

- The maximum light transmission is “84.6%” and it obtained at the ratio of 3% POF and 10% Flyash, or a curing period of 28 days.
- The ultimate compressive strength is “38.4 MPa” and it obtained at the point of 3% POF and 0% Flyash, or a curing period of 28 days.
- The maximum flexural strength is “19.7 MPa” and it obtained at the ratio of 3% POF and 10% Flyash, or a curing period of 28 days.

By this, we can conclude that the sample containing 10% Flyash with 3% Optical Fiber is best suitable in both strength criteria as well as light transmission criteria.

In general, too many openings needs to be provided for the case of ventilation purpose. But, by replacing the normal bricks with translucent concrete, opening are not required.

Most of the electricity will be produced from thermal power plants. Commercial buildings like offices, shopping complexes and banks consume much more electricity. In turn, pollution will get increased if the electricity consumption is more. But, by installing translucent concrete, electricity consumption can be reduced in a larger extent.

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