EXPERIMENTAL STUDY ON TRANSLUCENT CONCRETE WITH VARIABLE PERCENTAGE OF 1mm OPTICAL FIBER

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Abstract- Translucent concrete is a new technology which mainly focused on transparency of light from one side to another with minor loss of energy. This technology is a part of green technology which gives artistic finish. Translucent concrete is a combination of fine concrete in addition to a special type of material called Optical Fiber. This study mainly involves light transmission test in addition with compression and flexural tests by emerging 1% and 2% optical fiber.

Keywords—Light transmission test, Compression strength, flexural strengths, Optical Fiber

INTRODUCTION

Cement is an extremely fine mineral powder made in exact procedures. At the point when the concrete is blended with water, this powder changes into a glue which ties and get solidify. As the sythesis and fineness of the powder shifts, bond has various properties relying on its cosmetics.
Cement is the main component of concrete. It's a practical, excellent development material utilized in development ventures around the world

Fine aggregate is the idle or synthetically dormant material, the majority of which goes through a 4.75 mm IS strainer and contains not more than 5 percent coarser material. The particular gravity 2.75 and fineness modulus of 2.80 were utilized as fine aggregate. The free and compacted mass Density estimations of sand are1600 and 1688 kg/m^3 individually, the water ingestion of 1.1%.

An Optical fiber is a slim tube shaped formed fiber permits the light and the transmission is absolutely inward reflection and radiate the light out. An Optical fiber enables light waves with less vitality to travel long separation. Optical fiber comprises of high refractive file center made of plastic or glass.

LITERATURE REVIEW

M. Bill Price, et al (1999), He 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), Aron Losonczistudied 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), He 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.

OPTICAL FIBER ELEMENTS

Fig 1: Optical Fiber showing elements

CORE: The light travels through a thin glass center of the fiber called core.

CLADDING: The external optical material encompassing the center that mirrors the light again into the center. To limit the appearance in the center, the refractive file of the center must be more prominent than that of the cladding.

BUFFER COATING:- Optical Fiber is protected against moisture and damage by providing a Plastic coat called buffer coating.

CLASSIFICATIONS OF OPTICAL FIBERS

Optical fibers are categorized into 3 types on the refractive index profile basis and number of modes. They are:

1. Step index- single mode fiber, 2. Step index- multimode fiber, 3. Graded index –multimode fiber

From the above the first one step index-single mode fiber consists of core diameter 5-10μm. The light ray transmission is the only possibility by the core diameter. Around 80% of fibers gets manufactured in this world today in index single mode type only.

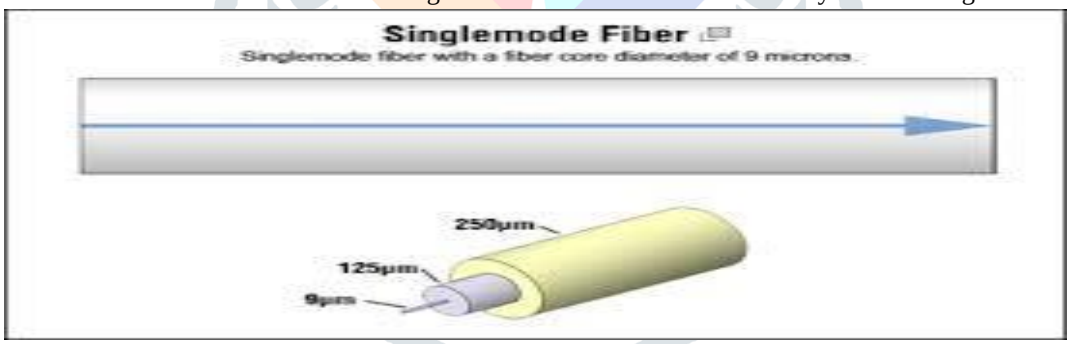


Fig. 2: Step Index Single Mode Fiber

The center distance across and outside breadth cladding of the progression list multimode fiber is 50 to 200μm and 125 to 300 μm. The estimation of refractive file is all of a sudden diminished from center to cladding in light of the fact that the cladding material is lesser and center material is of uniform refractive record. On the off chance that the center has bigger distance across, proliferation of numerous modes inside the fiber is permitted.

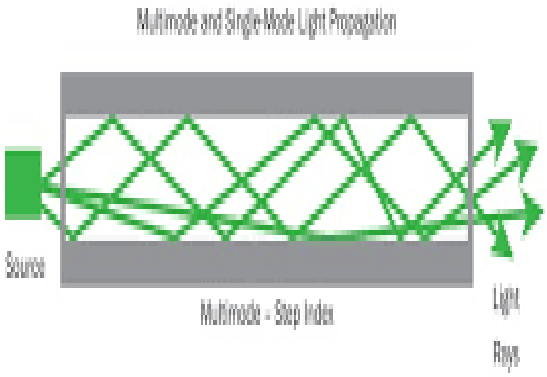


Fig. 3: Step Index Multimode Fiber

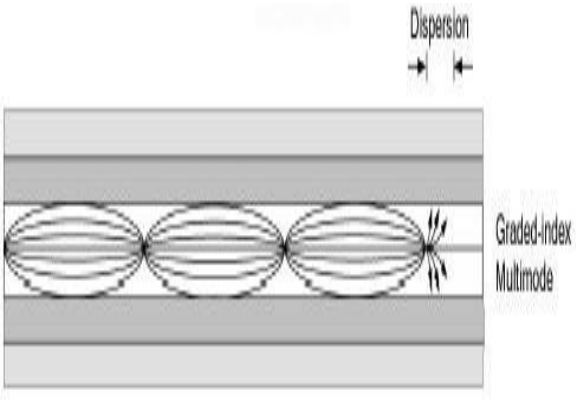


Fig. 4: Graded Index Multimode Fiber

The refractive record will be most extreme at the axis and diminishes towards the cladding in reviewed list multimode fiber. There will be a steady lessening in the refractive record and the modular scattering can be limited by the accompanying.

The standard behind the transmission of light waves is an all out inward reflection. The beneath clarification about the complete inside appearance in the dividers of the fiber:

i. Higher refractive file (n1) must be kept up to the glass around the focal point of the fiber than that of material encompassing the fiber (n2).

ii. The basic point littler than light should occurrence at an edge (between typical to the fiber divider and the way of the beam), θc.

TRANSPARENT LIGHT WEIGHT CONCRETE

It is a one of the material has new applications in development like embellishment, furniture and design. For this development a large number of optical fibers are utilized and organized next to each other on a solid base leaving for light go from one side to the next. The straightforward cement enlightens the light to inside so it limits the conventional light framework in the sunlight and furthermore makes a progressively sound condition for structure. Transparent light weight concrete is a compound of optical fibers and fine aggregate and cement, so itis a homogeneous material. Transparent walls are primarily used for decoration. Litracon Company says that it is a new technique and widely applicable for new buildings.

The POF was utilized for a development of keen straightforward cement by boring through the concrete and mortar so as to use the light managing capacity of POF. In this shrewd straightforward cement the fundamental thought is to utilize daylight as a light source so as to decrease the power utilization. Also, tests are directed and contemplated the mechanical exhibition of the solid imbued with POF were completed. Light transmitting rooms are help and closest items appearing on the more brilliant side of a light transmitting solid divider, it will be uncovered as structure on the opposite side.

OBJECTIVES AND DETAILS OF PRESENT INVESTIGATION

- **Step – I**: Mould preparation of different sizes 15 cm x 10 cm x 10 cm, 50 cm x 10 cm x 10 cm for the casting of translucent concrete blocks.
- **Step – II**: Fixing the POF through the holes provided in the mould and fix it.
- **Step – III**: Filling the cement mortar to the concrete bricks and moulds.
- **Step – IV:** Preparing ordinary concrete blocks and similarly preparation with replacement of fly ash concrete blocks in different percentages 10%, 20% & 30% in addition with Optical Fiber of 0%, 1%, 2%.
- **Step – V**: Prepared translucent concrete blocks and also prepared with replacement of fly ash concrete blocks in different percentages 10%, 20% & 30% in addition with Optical Fiber of 0%, 1%, 2%.
- **Step – VI:** Casting the blocks for 7 days and 28 days.
- **Step – VII**: To determine the light transmitting test, compression strength and flexural strength for both normal &

translucent bricks and moulds.

MANUFACTURING PROCESS

I. PREPARATION OF MOULD

Moulds of rectangular cross sections of the sizes 500mm x 100mm x 100mm and 150mm x 100mm x 100mm are made with wood or steel. The preparation of mould for translucent concrete is a challenging task for cubes why it becomes difficult means the insertion of the fiber is a challenging task. Insertion in the transverse direction makes it more significant for our results. Based on the adoption of the size of the optical fibers the holes are drilled on the two opposite side of the mould walls and the holes to insert the optical fibers are placed at regular intervals

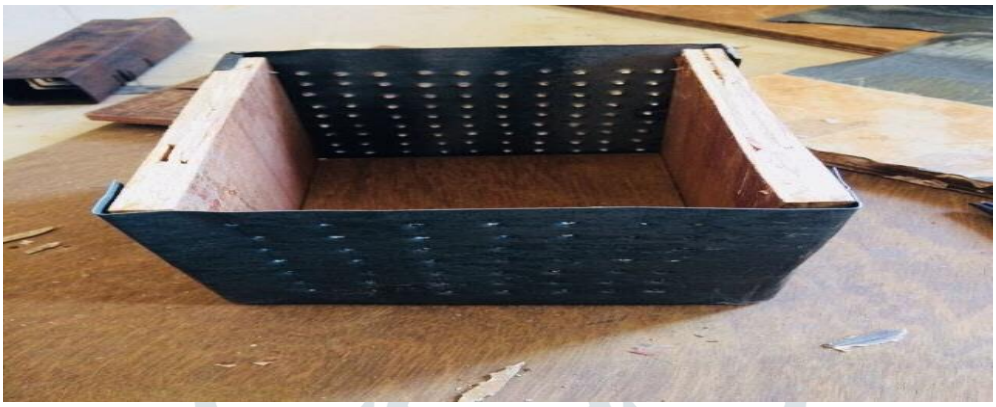


Fig. 5: Mould Diagram

II. FIXING THE FIBERS

The wooden or steel plates which optical fibers are allowed to pass through mould initially or otherwise it becomes difficult after fixing the fibers to the mould The fixing of fibers is a laborious and time consuming process. Apply the oil to the way to fix the mould is represented in the following figure

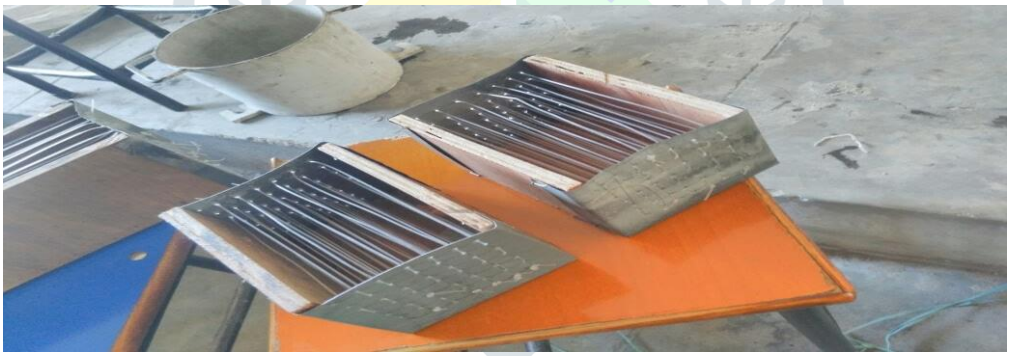


Fig. 6: Fixing the Fibers

III. CONCRETING

The altogether blended cement is poured cautiously and gradually without making numerous unsettling influences the recently laid optical fibers. To avoid the formation of voids the concrete is agitated and filled in thinner and smaller layers with the help of vibrating tables.

The mix proportion that we adopted here is 1:2 then the placing of the concrete in between the fibers is difficult task for the project. The compaction should be proper to avoid voids in the block if not done properly the voids will lesser the strength of the concrete we will be not able to obtain the desired results. We may also use the vibrator for the purpose of compaction but take care it may leads to bleeding also

Fig. 7: Concreting the Mould

IV. CUTTING AND REMOVING THE MOULD

By checking the thickness of the panel, outside if there are extra-long fibers those must be cut to maintain equal size. After that remove the mould and the casted mould was kept undisturbed on the levelled platform. Then it was de moulded carefully from casting. Immediately after de-moulding, the cube specimens were marked by their respective identification mark/numbers then place it into the water then test it.

EXPERIMENTAL INVESTIGATION

TESTS ON TRANSLUCENT CONCRETE

- Light transmitting 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.

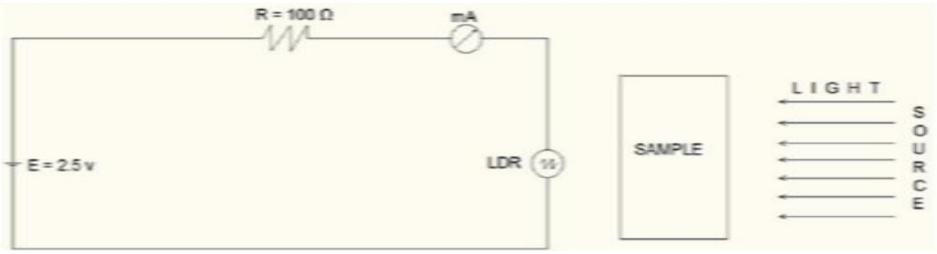


Fig. 8: Circuit Diagram

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

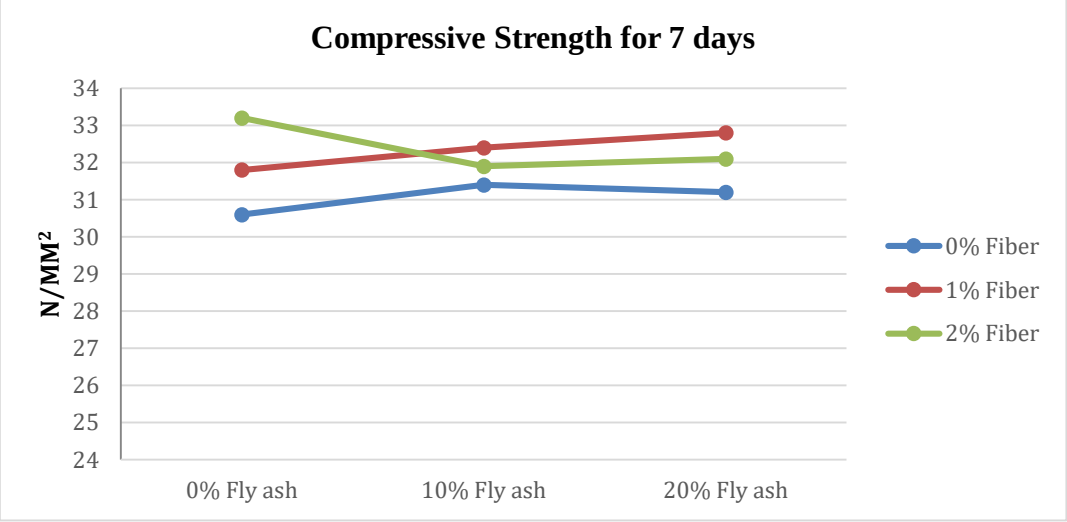
It is the ability of a beam or slab to bear the bending. Ordinarily the strength is 12 to 20% of compressive strength. It is valuable for field control and acknowledgment for pavement. However at this point multi day's it isn't utilized to decide field control, just compressive quality is anything but difficult to pass judgment on the nature of cement.. To determine the flexural strength of concrete four numbers of prisms were casting. Then it was cured properly.

TEST RESULTS

COMPARISON OF COMPRESSIVE STRENGTH RESULTS

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

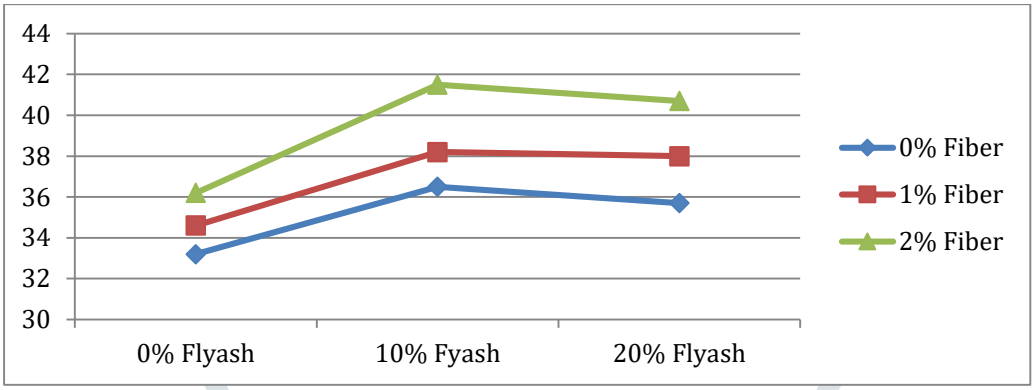
% of Fly ash	% of Fiber		
	0%	1%	2%
0%	30.6	31.8	33.2
10%	31.4	32.4	31.9
20%	31.2	32.8	32.1



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%	2%
0%	33.2	34.6	36.2
10%	36.5	38.2	41.5
20%	35.7	38.0	40.7



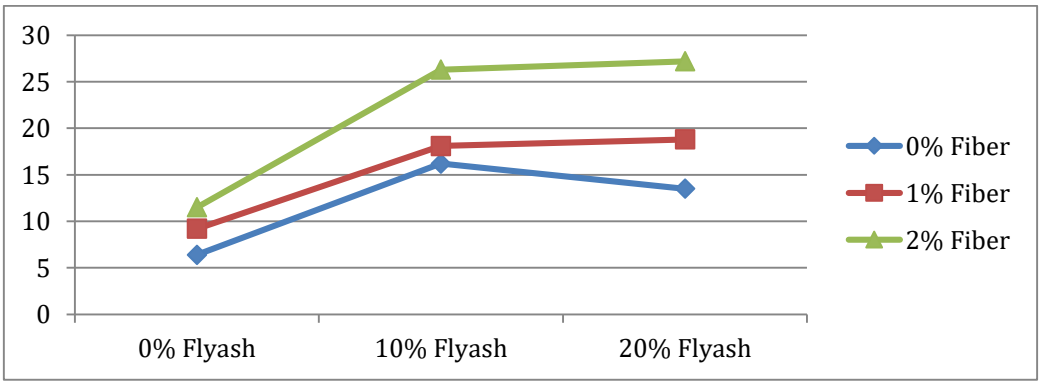
Graph 2: Comparison of compressive strength for 28 Days

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)

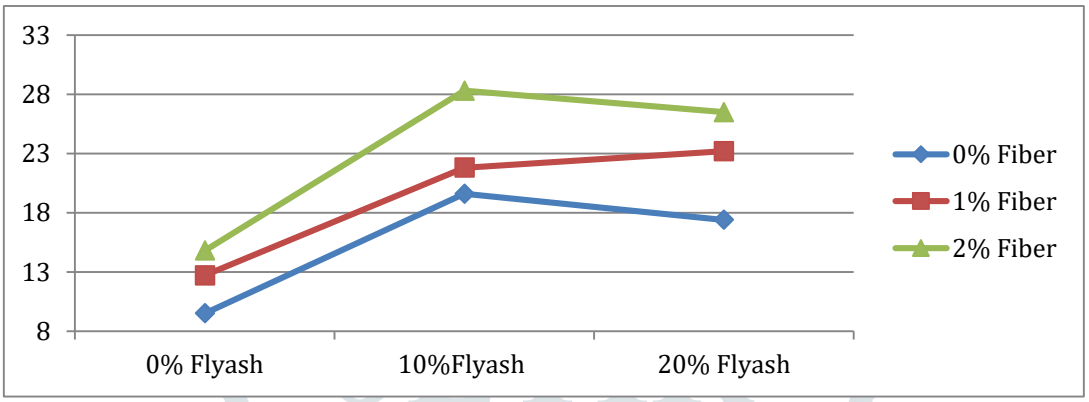
% of Fly ash	% of Fiber		
	0%	1%	2%
0%	6.4	9.2	11.5
10%	16.2	18.1	26.3
20%	13.5	18.8	27.2



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%	2%
0%	9.5	12.7	14.8
10%	19.6	21.8	28.3
20%	17.4	23.2	26.5

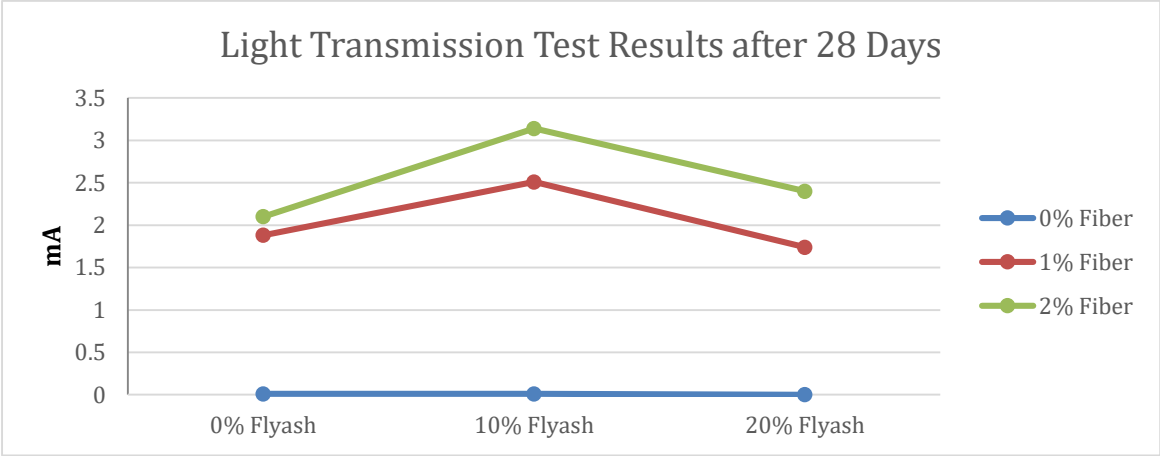


Graph 4: flexural strength for 28 days

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%	2%
0%	0.01	1.88	2.10
10%	0.01	2.51	3.14
20%	0.00	1.74	2.40



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 2% Fiber allows the light to a larger extent of about 3.14 mA.
- In general when the light transmission test was conducted with no sample, it was about 4.0 mA.
- Hence it can be concluded that the sample with 10% Flyash & 2% Fiber allows the light of about 77.5% 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 8.1 that the sample containing 0% Flyash with 2% Optical Fiber has comparatively higher value of about 33.2 N/mm^2.
- When compared with the original sample, the value of the above proportion has increased for about 2.6 MPa.

Compressive Strength Test after 28 Days:

- When the compressive strength values are compared after 28 days curing, it was found from the table 8.2 that the sample with 10% Flyash and 2% Optical Fiber has got a higher value of about 41.5 N/mm^2.
- When compared with the original sample, the value of the above proportion has increased for about 8.3 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 20% Flyash with 2% Optical Fiber has got a higher value of about 27.2 N/mm^2.
- When compared with the original sample, the value of the above proportion has increased for about 20.8 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 2% Optical Fiber has got a larger value of about 28.3 N/mm^2.
- When compared with the original sample, the value of the above proportion has increased for about 18.8 MPa.

CONCLUSIONS

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

- The maximum light transmission is “77.5%” and it obtained at the ratio of 2% Fiber and 10% Flyash, or a curing period of 28 days.

- The ultimate compressive strength is “41.5 MPa” and it obtained at the point of 2% Fiber and 10% Flyash, or a curing period of 28 days.

- The maximum flexural strength is “28.3 MPa” and it obtained at the ratio of 2% Fiber and 10% Flyash, or a curing period of 28 days.

By this, we can conclude that the sample containing 10% Flyash with 2% 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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