STRENGTH AND LIGHT TRANSMITTANCE PROPERTIES OF TRANSLUCENT CONCRETE

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Abstract
Translucent Concrete is a kind of transparent concrete by introducing Plastic Optic Fiber. It is used in fine architecture as a front of building material and for cladding of interior walls. The light transmittance performance of Plastic Optical Fiber (POF) based Translucent Concrete was evaluated using an electrical circuit test setup with Light Dependent Resistor (LDR). The intensity of light transmitted through translucent concrete gradually decreases with respect to increases in distance between LDR and specimen. The spacing, diameter and number of optical fibers have a considerable effect on the overall ratio of light transmitted. Light is conducted through stone from one end to the other. Therefore, the fibers are need to arrange through the whole object. Transparent concrete is also known as the translucent concrete and light transmitting concrete because of its properties. In this report, to integrate the merits of concrete and optical fiber, for developing transparent concrete by arranging the high numerical aperture Plastic Optical Fibers (POF) or big diameter glass optical fiber into concrete. The main purpose is to use sunlight as a light source to reduce the non-renewable energy. Consumption of illumination and to use the optical fiber to sense the stress of structures and also use this concrete as an architectural purpose for good aesthetic view of the building. The binding material in transparent concrete which is able to transmit light by using clear resins the concrete mix. The paper circumscribes with the need of transparent concrete at present to utilize the sunlight and for architecture technologies. The new type of concrete can satisfy the green energy saving with its own Natural properties. The compressive strength of translucent concrete depends upon the amount of fiber content present

INTRODUCTION

1.1 GENERAL

Energy conservation is a key and emerging global issue for sustainable infrastructure development. The building sector energy demand accounts approximately 34% of the world's energy demand. Artificial lighting consumes around 19% of the total delivered electricity, worldwide. The electric lighting demand has constantly been increasing with the increase in the population, urbanization and construction of high-rise buildings. The production of electricity contributes to the increase in the greenhouse gas emissions. improving lighting designs and using lighting control systems. Translucent concrete is an innovative solution towards significantly reducing the need for artificial lighting.

This in turn reduces the carbon footprint by allowing transmission of natural light into building's interior when the translucent concrete is used as structural façades and architectural walls, thus fostering the development of green buildings. Translucent concrete can be produced in an even distribution and parallel spatial pattern arrangement of plastic optical fibers embedded with self-compacting mortar or fine concrete matrix. The light transmittance properties rely on the volume ratio and numerical aperture of optical fibers incorporated. Plastic Optical Fiber (POF) is an optical fiber made of Poly Methyl Methacrylate (PMMA) core and fluor resin cladding materials with more than 96% of the cross-section able to transmit light effectively. The structural components of optical fiber consist of three layers: core, cladding and buffer coating. the light transmittance of translucent concrete using optical fiber of less than 1.5 mm diameters. The aim of this experimental study is to evaluate the light transmittance performance of translucent concrete containing optical fiber diameters of 2 mm and 3 mm using Light Dependent Resistor (LDR) for application in building.

1.2 NEEDS

To illuminate the wall, for decorative purposes, to give artistic finish, to save electricity, to increase visibility in dark area, to give aesthetic view.

1.3 APPLICATIONS

Digital advertising space, facades, infrastructure project, pavings, wellness area, partition wall, company entrances.

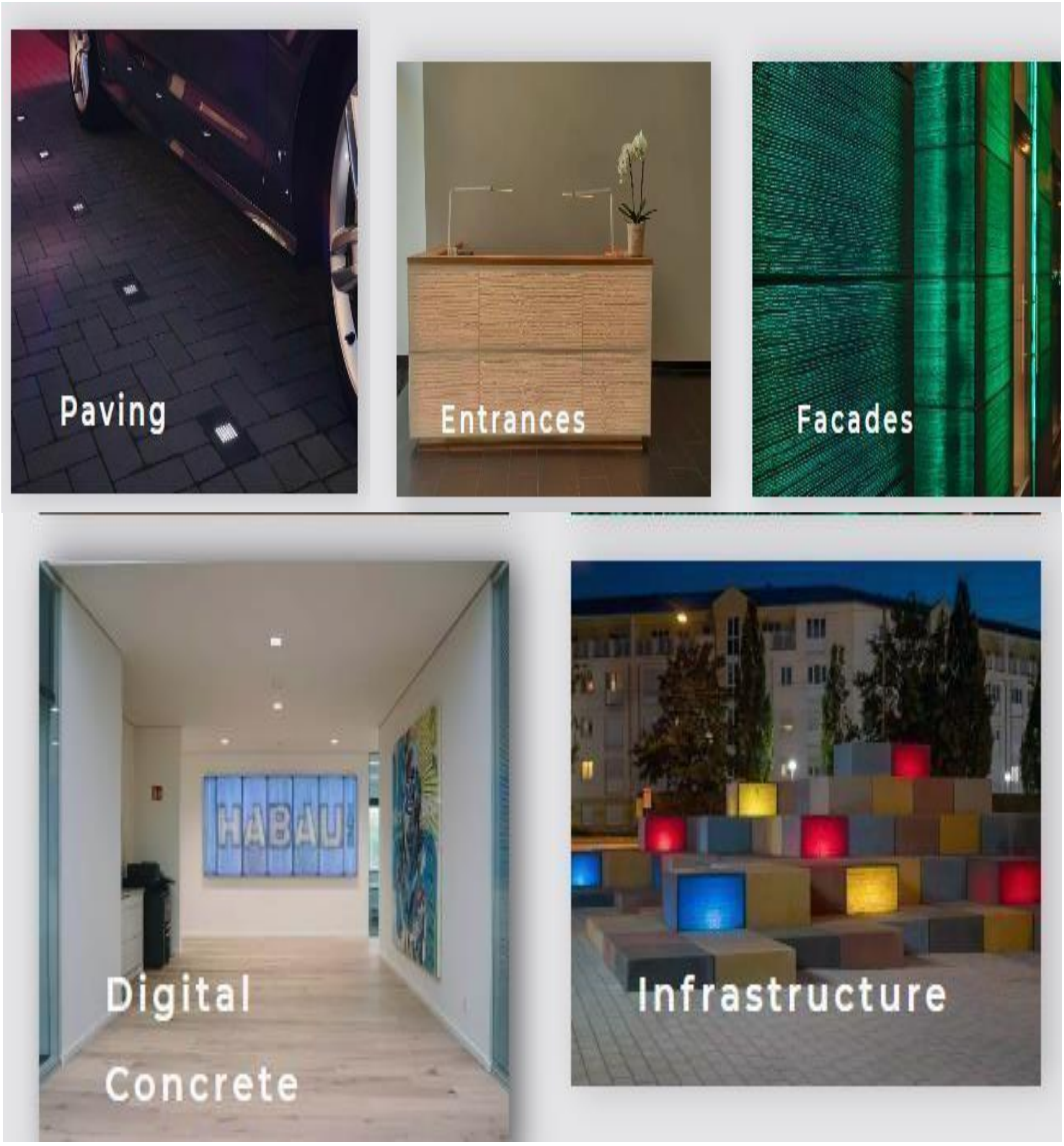


Fig. 1.1: Applications of Translucent Concrete.

1.4 OBJECTIVES

- To model a special type of construction material “Light Transmitting Concrete.
- To study the light transmittance intensity of light transmitting concrete using natural source of light of known intensity with respect to varying diameter of Plastic Optical Fiber (POF) in the Light Transmitting Concrete (LTC).

1.5 SCOPE OF THE STUDY

- To study a Translucent Concrete using specified percentage of POF in order to find light transmittance during the day time.
- To evaluate the effectiveness of POF in the M30 grade concrete, properties of concrete with and without POF will be

determined by using compressive strength test.

LITERATURE SURVEY

2.1 STUDIES ON PREVIOUS LITERATURES

Ahmed M. Tahwia, et. al. (2022): The work aims to produce an innovative new construction material (HPTC and UHPTC) and investigate the mechanical and light transmittance behavior as well as the relationship between them. the HPTC mechanical properties increase with increasing POF volume ratios and diameters, the light transmittance significantly increases with increasing POF volume ratios. In this paper, HPTC performs up to 21.35% light transmittance for specimens with a volume ratio of 4% POF and 2 mm POF diameter as wel, as good mechanical properties such as compressive of 54.30 MPa at 91 days.

Aditya Katore, et. al. (2022): In this paper we are casting a block and slab of size 18×7×7 cm3 & 100×7×300cm3 respectively by using cement, sand, aggregate, with optical fiber & glass. In this research paper we should try to reduce its cost by using glass rod with the small composition of optical fiber. We observed the light transmission in this block is 9095% & minor loss of energy can be observed. The strength of slab by using optical fiber is increased 4-5% in the comparison of the normal block & slab. Slump cone test is preferred to check the workability of the concrete & during this test the observed slump is 92mm. The compressive strength test checked in 7,
14& 28 days are10 N/mm2,20 N/mm2,30 N/mm2.flexural strength test checked in 7,14,&28 days are 3N/mm2,3.5 N/mm2,4 N/mm2.

Raja Ganapathi et. al. (2021): In this study the compressive strength of the concrete is determined by the cube size of 150 x 150 x 150 mm and then applying the load gradually without the shock and continuously at the rate of 140 kg/cm2 /minute till the specimen fail Both the conventional and translucent concrete samples, cast with same mix design, were subjected to compressive strength test at 7-day and 28-day. respectively. The compressive strength for 28 days is 20.4 N/mm2. It can be observed that the volume of proportion affects the compression strength of the concrete block for less than 10% when the proportion ratio of the optical fiber is less than 5%. Usha K N et. al. (2020): The paper reports on investigation on the behaviour of concrete with optical fibers and compared with conventional concrete of M20 grade. 2mm and 3mm diameter optical fibers with varied percentage from 1% to 3% were studied. The efficiency of the application of optical fiber is studied by comparing the strength with the normal M20 grade concrete and the test results proved that the efficiency is more in all aspect. The compressive strength of translucent
concrete is seen to increase with the increase in fiber content. For 7 days strength of translucent concrete of 2% POF gives 22.89N/mm2 which is 16.5% more than the conventional concrete for 28 days 26.67 N/mm2. The POF of 2% in translucent concrete showed flexural strength of 4.77N/mm2 which is 4.4% greater than conventional concrete.

Chandan swain,et. al. (2022): This paper especially covenant with the translucent concrete and also future advantages usage of smart construction world, usages of transparent concrete is a concrete based building material with having light-Trans missive properties due to embedded light optical elements usually Optical fibers. The work presented in this project reports an investigation on the behavior of concrete and mortar with optical fiber.

Concrete and mortar cube are casted with fibers to study the properties and to compare the compressive strength between normal mix concrete with optical fiber and normal mortar without optical fiber after 7 days, 14 days and 28 days respectively. The compressive strength of concrete samples made with different fiber amount varies from 4% to 5% are 8.88 N/mm2,11.45 N/mm2,12.8N/mm2. The compressive strength without fiber's are 9.56,13.02,15.24(N/mm2)

S. venkatesh1 et. al. (2022): In this paper the main objectives is to study the values of compressive strength and density of concrete cubes of 100mmX100mmX100mm is measured for various percentages of fibers from 0% to 1.9%.Main aim is to design translucent concrete blocks with the use of glass rods & optical fibers with sand & cement then analyze their various physical & engineering properties with respect to conventional concrete blocks by adding glass rods & optical fibers of 1%,1.3 %, 1.6% and 1.9% of concrete mix weight at 1 cm spacing respectively. The POF of 2% in translucent concrete showed compressive strength for 7,14,28 days are

9,14.5,17 (N/mm2). The Transmittance (Ratio %) of 100w and 200w increases with increasing the percentage of the POF. Density of light transmitting concrete decreases with increasing the percentage of the POF. 5. The value of compressive strength for 7, 14 and 28 days of curing decreases with increasing the percentage of the POF.

2.1 SUMMARY OF LITERATURES

Literature on POF it included studies on the methodology and application of POF, and comparisons of the conventional concrete and concrete with plastic optic fiber., and evaluations of compressive strength test and light transmittance and other properties based on the varying percentage of POF. From this literatures it can summarizes the light transmittance increases with increase in POF volume ratios. strength of the translucent concrete is inversely proportional to light transmittance. it is noticed that the failure occurred in interfacial transition zone between the POF and cement paste, this is due to the smoothness of the optic fiber surface. Coarse aggregate may destroy the optical fibers and changes their properties. The literature also discuss about the utilization of potential which is present in the form of sunlight.

2.2 RESEARCH GAP

There are no researchers conducted on translucent concrete of M30 grade concrete. In this project we are going to evaluate the transparency of M30 grade concrete with plastic optical fiber only through the natural source with variations in time. Usually conventional concrete is unable to transmit lights, so it is not a energy saving building material, and also unable to add the beauty of the interior by illuminating the area. Translucent concrete can be one of the solution for above mentioned problems. The biggest challenge that restricting its use in wide scale is its low strength. In our project we try to find a solution for this by using high concrete mix.

CHAPTER 3
MATERIALS AND METHODOLOGY

3.1 MATERIALS USED

3.1.1 Cement of Grade 53

A cement is a binder, a substance used for construction that sets, hardens, and adheres to other materials to bind them together. Cement is seldom used on its own, but rather to bind sand and gravel together. Cement mixed with fine aggregate produces mortar for masonry, or with sand and gravel, produces concrete. The cement used is COROMANDEL KING OPC Grade 53.

Fig. 3.1:cement

3.1.2Fine aggregate

Sand is naturally available material which is composed rock and mineral particles. Size sand should pass through 1.18mm sieve. It should be free from impurities and organic matters. Fine aggregates are essentially sands won from the land or the marine condition. Fine aggregates by and large comprise of common sand or smashed stone with most particles goingthrougha4.75mmsifter.

Fig .3.2: Sand

3.1.3 Coarse Aggregates

Coarse aggregates refer to irregular and granular materials such as sand, gravel, or crushed stone, and are used for making concrete. In most cases, Coarse is naturally occurring and can be obtained by blasting quarries or crushing them by hand or crushers.

Aggregate materials help to make concrete mixes more compact. They also decrease the consumption of cement and water and contribute to the mechanical strength of the concrete, making them an indispensable ingredient in the construction and maintenance of rigid structures. The maximum size of the selected coarse aggregate is 20 mm. It is collected from the nearby shop.

Fig.3.3:coarse aggregate

3.1.4 Plastic Optic Fiber

Plastic Optic Fiber (POF) is a type of optical fiber made from polymer materials, such as polymethylmethacrylate (PMMA). Unlike traditional glass fibers, POFs have a larger core diameter, typically ranging from 0.5mm to 2mm, which allows them to transmit visible light rather than infrared light. Here we use 1mm diameter POF.

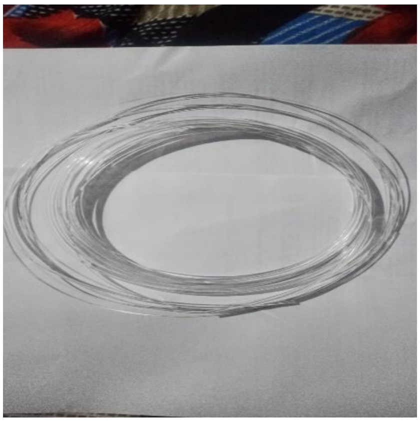


Fig. 3.4: Plastic optic fiber

3.1.5 Admixtures

Superplasticizers are commonly used in dry-pressed concrete to improve the workability and to enhance the compaction of concrete for increasing density and to improve the surface finish of the concrete product. The role of the superplasticizers as1. To increase the workability of concrete without any change in the composition of the mix. 2. To reduce the water content of mixing water, to reduce the water/cement ratio resulting in the increase of strength and durability of concrete.

Fig.3.5: ESCON

3.1.6. Water

Water is a key ingredient in the manufacture of concrete. Water used in concrete mixes has two functions: the first is to react chemically with the cement, which will finally set and harden, and the second function is to lubricate all other materials and make the concrete workable. Although it is an important ingredient of concrete, it has little to do with the quality of concrete. One of the most common causes of poor-quality concrete is the use of too much mixing water.The water at a range of 6.5-8.5 is used which is portable.

3.2 METHODOLOGY

Mix design is done according to the IS design method and numerous trial mixes were conducted to get optimum mix. Once the optimum mix is determined, it is used to produce concrete specimens with plastic optic fiber. The concrete is prepared to find out the compressive strength, split tensile strength and light transparency.

3.2.1 Mould

The wooden mould should be in the size of 15 x20 x3cm in size and the wooden mould should be screwed by screw for the reusing the mould for the concrete preparation. Holes are drilled into the mould, the diameter of holes and number of holes mainly depends on percentage of fiber used.

Fig.3.6:15x20x3 cm (mould)

3.3 PRELIMINARY TEST

To examine the basic properties of the materials chosen the following tests were carried out.

3.3.1 TESTS ON CEMENT

Various tests on cement are performed to evaluate the standard consistency, initial and final setting time.

3.3.1.1 Standard Consistency Test for Cement

About 500 g of cement was weighed accurately and placed in an enamel trough. To start with, add clean water and mixed it thoroughly with cement. Care should be taken that the time of gauging is not less than 3 minutes and not more than 5 minutes. The gauging time shall be counted from the time of adding water to the dry cement until commencing to fill the mould. The Vicat's mould was filled with this paste. Make the surface of the cement paste in level with the top of the mould with at rowel. The mould was placed under the rod bearing the plunger. The indicator was adjusted to show 0-0 reading when it touched the surface of the test block. The plunger was released quickly, allowing it to sink into the plate. The trial paste was prepared with varying % of water and the test was repeated as described above until the needle penetrates 5mm to 7mm above the bottom of the mould. The amount of water was expressed as percentage by weight of the dry cement.

$$Standrd\ consistency = \left(\frac{Quantity of\ water for 5\text{–}7 mm penetration}{Weight of\ \text{cement} \times 100} \right)$$

Sample	Cement
Specification	OPC 53 (Coromandel king)
Standard Consistency	27%

Table 3.1: Standard consistency Test for cement

3.3.1.2Initial and Final Setting Time of cement

The initial setting time of concrete is the time when cement paste starts hardening while the final setting time is the time when cement paste has hardened sufficiently in such a way that a 1 mm needle makes an impression on the paste in the mould but 5 mm needle does not make any impression. Time about 500 grams of cement was weighed. A neat cement paste was prepared by adding 0.85 times the percentage of water required for standard consistency. The stopwatch was started at the instant when water was added to the cement. The Vicat's mould was filled with the cement paste prepared. Gauging time should not be less than 3 minutes and more than 5 minutes. Filled the mould completely and smoothened the surface of paste making it level with the top of the mould to give a test block. The test block was placed confined in the mould under the load bearing medium. Lowered the needle gently till it came in contact with the surface of test block and was quickly released, allowing it to penetrate the test block and noted penetration after everytwo minutes. This procedure was repeated until the needle failed to pierce the block for about 5mm, measured from the bottom of the mould. The stopwatch was stopped and the initial setting time was noted.

Fig. 3.7: Vicat Apparatus

Table 3.2: Initial setting time of cement

Sample	Cement
Specifications	OPC 53 (Coromandel king)
Initial Setting Time	30 minutes

3.2.1.3 Specific Gravity of Cement

To determine specific gravity of cement Le-Chatliers flask is used. Dry the flask carefully and fill with kerosene to a point on the stem between zero and 1ml.Record the level of liquid in the flask as initial reading. Put a weighed quantity of cement in to the flask so that level of kerosene rises to about 22ml mark. Note down the new liquid level as final reading. Specific gravity of cement = Weight of cement used/weight of equal volume of water

$$= \frac{W}{V_2 - V_1}$$

Table 3.3:Specific Gravity of Cement

Sample	Cement
Specifications	OPC 53 (Coromandel king)
Specific Gravity	3.16

3.3.2 TESTS ON COARSE AGGREGATES

Coarse aggregates are very important component of concrete, so its quality so its quality really matters. Various tests such as sieve analysis, impact value test are performed on coarse aggregates to check its quality.

3.3.2.1 Specific Gravity of Coarse Aggregate

Specific gravity of coarse aggregate is determined using density bucket. Take 2 kg of aggregate sample larger than 10mm.Wash the sample thoroughly to remove finer particles and dust. The sample in a wire basket and immerse it in distilled water at a temperature between 22 and 32 degree Celsius with a cover of at least 5cm of water above the top of the basket, weigh (W1) with the sample in the water. Remove the basket and aggregate from water and allow to drain for a few minutes. Empty the aggregate from the basket to shallow tray. Immerse the empty basket in water jolt 25 times and then find the weight in water(W2).Place the aggregate in oven at a temperature of 100 degree Celsius. Remove it from the oven and cool it and find the weight (W3).

Apparent specific gravity=weight of a substance/weight of an equal volume of water

Specific gravity= $$\left(\frac{W3}{W3-(W1-W2)}\right)$$

Fig. 3.8: Wire mesh bucket

Table 3.4: Specific Gravity of Coarse aggregate

Sample	Coarse aggregate
Specifications	Passing through 25 mm IS sieve and retained on 4.75 mm IS sieve
Specific Gravity	2.81

3.3.2.2Water Absorption of Coarse Aggregates

1 kg sample is taken and immersed in water for 24 hours. Note the reading after 24 hours (W2).

$$WaterAbsorption = \left(\frac{\quad}{W2}\right)$$

Table 3.5: Water absorption of coarse aggregate

Sample	Coarse aggregate
Specifications	Passing through 25 mm IS sieve and retained on 4.75 mm IS sieve
Water absorption	0.7%

3.3.2.3 Sieve Analysis Test of Coarse Aggregates

Coarse aggregate is the gravel used in mortars. Take 5 kg of coarse aggregate. Arrange the sieves one over the other in relation to their size of opening (25mm, 19mm, 12.5mm, 9.5mm, 6.3mm, 4.75mm). Carry out the sieving for the specified time. Find out the weight of aggregate retained on each sieve taken in order and tabulate. The laboratory test on sieve analysis of coarse aggregate was conducted.

Table 3.6: Sieve analysis of coarse aggregate

Sample	Coarse aggregate
Fineness modulus	4.106

3.3.2.4Impact Value Test of Coarse Aggregates

Aggregates Impact Value Test gives relative measure of resistance of aggregates to sudden shock or impact, which in some aggregates differs from its resistance to slow compression load. The test sample consists of aggregates sized 10mm 12.5 mm. Aggregates may be dried by heating at 100-110° C for a period of 4 hours and cooled. Sieve the material through 12.5 mm and 10.0mm IS sieves. The aggregates passing through 12.5mm sieve and retained on 10.0mm sieve comprises the test material. Weigh the corresponding fractions and place it to impact machine and weigh the fraction after it pass through 2.36mm and find out average impact value of coarse aggregates.

Fig 3.9:Aggregate impact value

Table 3.7: Aggregate impact value

Sample	Coarse aggregate
Impact value	10.6%

3.3.3 Tests on Fine Aggregates

Fine aggregates are very important component of concrete, so its quality really matters. Various tests such as specific gravity, sieve analysis is performed on fine aggregates to check its quality. Specific gravity test of aggregates is done to measure the strength of the aggregates

3.3.3.1 Specific Gravity of Fine Aggregates

The Pycnometer was cleaned, dried and weighed accurately with its cap screwed on (W1). About 300g to 500g of oven dry sample in the Pycnometer was taken and weighed again (W2). Distilled water was added in the Pycnometer and stirred using glass rod to remove the entrapped air. Filled the Pycnometer with distilled water up to the hole in the conical cap and weighed it (W3). The Pycnometer was emptied and cleaned. Filled the Pycnometer with distilled water up to the hole in the conical cap and weighed it (W4).

Specific Gravity= $\left(\frac{W2}{W2-(W-W1)}\right)$

Fig.3.10:Pycnometer

Table 3.8: Specific gravity of fine aggregate

Sample	Fine aggregate
Specification	Passing through 4.75mm and retained on 0.15mm
Specific Gravity	2.66

3.3.3.2 Water Absorption of Fine Aggregates

1 kg sample istaken and immersed in water for 24 hours. Note the reading after 24 hours(W2).

$WaterAbsorption$= $\left(\frac{W1-W2}{W2\ x100}\right)$

Table 3.9: Water absorption of fine aggregate

Sample	Fine aggregate
Specifications	Passing through 4.75mm and retained on 0.15mm
Water absorption	1.8%

3.3.3.3 SieveAnalysis of Fine Aggregates

About 1 kg of fine aggregate was taken in IS sieve size of 4.75mm, 2.36mm, 1.18mm, 600µ, 300µ, 150µ, pan was arranged in the decreasing order of size andput the coarse aggregate taken. Sieved the aggregates and the amount which is passing through greater size was taken and retained on the next. A graph of Percentage finer versus sieve size was plotted with the values obtained from the tests.

Table 3.10: Sieve analysis of fine aggregate

Sample	Fine aggregate
Fineness Modulus	2.39

3.4 MIX DESIGN FOR M30 GRADE CONCRETE (IS 456:2000&IS 10262:2019)

1. STIPULATION FOR PROPORTIONING

- Grade designation = M30
- Type of cement grade = OPC 53 Grade
- Max. size of coarse aggregate = 20 mm
- Exposure condition =Sever
  (IS 456 -2000, Table 5, pg.20)
- Min. cement content = 320 kg/m3
- Max w/c ratio = 0.45
- Workability in terms of slump = 100mm
- Max cement content = 450kg/m3
  (IS 456-2000 Cl.8.2.4.2, Pg.10)
- Aggregate = zone II (IS 456-10262-2019)
- Critical admixture type : super Plasticizer

2. TEST DATA FOR MATERIALS

- Specific gravity of cement = 3.16
- Specific gravity of coarse aggregate = 2.81
- Specific gravity of fine aggregate= 2.66

3. TARGET STRENGTH FOR MIX PROPORTION

f'ck = fck+(1.65×S)
S=5 (IS 10262.2019-Table 2-pg.3)
fck =35 N/mm2
f'ck =30 + (1.65×5) =38.25N/mm2

4. SELECTION OF W/C RATIO

w/c ratio for target mean strength = 0.42 (Pg. 4, IS 10262)
Exposure condition = Severe
w/c ratio for exposure condition = 0.45
0.42< 0.45, Hence Ok

5. APPROXIMATE AIR CONTENT

For 20mm nominal max. size of aggregate , approximate amount of entrapped air = 1% (Table 3 page 3 IS 10262)

6. SELECTION OF WATER CONTENT

For 20mm max. size aggregate water content = 186 kg (Table 4, pg. 5 IS 10262)
Estimated water content for 25mm slump (Increasing at rate of 3% for every 25mm slump) =186 +(3/100)×186 =191.58 kg
As Superplasticer is used water content maybe reduced to 20 – 30%
Considering water content reduction by 23%
Water content =191.58 –(23/100)×191.58=148 Kg

7. SELECTION OF W/C RATIO

w/c ratio for target mean strength = 0.42 (Pg. 4, IS 10262)
Exposure condition = Severe
w/c ratio for exposure condition = 0.45
0.42< 0.45, Hence Ok

8. APPROXIMATE AIR CONTENT

For 20mm nominal max. size of aggregate, approximate amount of entrapped air = 1% (Table 3 page 3 IS 10262)

9. CALCULATION OF CEMENT CONTENT

w/c ratio = 0.42
Cement Content =Water content
w/c ratio= 148 = 352.38 = 353kg/m3
0.42 353kg/m3 > 320kg/m3

10. PROPORTION OF VOL. OF CA & FA

Proportionate vol. of CA corresponding to 20mm nominal size of CA & FA (zone II) for w/c 0.50 = 0.62 (Table 5 pg. 6 IS 10262) Change in w/c ratio = 0.50 – 0.42

0.08

Corrected proportion of vol of CA for w/c ratio 0.42 = 0.62 + × 0.01= 0.08

0.05

11. MIX CALCULATION

- Total volume = 1m3
- Volume entrapped air = 1% = 0.01
- Volume of cement = mass of cement ×1
- Specific gravity of cement 1000 = 353 × 1/3.161000 = 0.112 m 3
- Vol of water = mass of water ×1/Specific Gravity of water =(148/1)×(1/1000)=0.148 m3
- Vol. of chemical admixture = mass of chemical admixture × 1(1% by mass of cementitious material)
  = 353 × 0.01 × 1 = 0.00294 m3
- Vol. of total aggregate = [(total vol .(a) –[(vol of entrapped air (b) + (vol of Cement (c)+ vol of water (d) + vol of chemical Admixture)]
  = [(1)-(0.01+ 0.112 + 0.148 + 0.00294)]
  = 0.727 m3
- Mass of CA= Vol of total aggregate × vol. of CA × sp. gr. Of CA × 1000
  = 0.727 × 0.636 × 2.81 × 1000
  = 1299.26 = 1300 kg
- Mass of FA = Vol. of total aggregate × Vol. of FA × Sp. gr. of FA × 1000
  = 0.727 × 0.364 × 2.66 × 1000
  = 703.9 = 704kg
- Mass of chemical admixture = Vol. of total aggregate × Vol. of chemical Admixture × spc. gr. of admixture × 1000
  = 0.727 × 0.00294 × 1.2 × 1000
  = 2.56 kg
- Mix proportion for trail mix
- Cement = 353 kg/ m3
- Water = 148 kg / m3
- CA = 1300 kg/ m3
- FA = 704 kg/ m3
- Admixture = 2.56 kg/ m3
- w/c ratio = 0.42
- Ratio of M30 mix = C : FA : CA=353∶ ∶:704:1300
  353 353 353
  = 1 : 1.99 : 3.68

Table 3.11: Optimum mix preparation of M30 grade.

Materials	Water (L)	Cement (Kg)	Fine Aggregate (Kg)	Coarse Aggregate (Kg)	Super plasticizer s(L)
Quantity of 1m^3 of Concrete	148	353	704	1300	2.56
Mix ratio	0.42	1	1.99	3.68	0.0072

3.5 CASTING AND PREPARATION OF SPECIMENS

3.5.1 Preparation of Cube specimens

At first, the water cement ratio and cement aggregate mass ratio was fixed as 0.45 and 1:1.99:3.68 as per mix design procedure. In addition to that, plastic optic fibre is also added, in order to study the compressive strength of cubes with or without POF.. All the materials required to cast standard concrete cubes of dimension 15x15x15 cm were batched by weight as per the mix proportions. They were uniformly mixed by hand mixing. The concrete is filled in 3 layers in a standard cube mould (150x150x150 mm) and is properly compacted using a tamping rod each layer with 25 times and the exposed faceof concrete at the top is made even with trowel.Twelve cubes are casted, All these casted cubes are immersed in the curing tank for 7,14,28 days

.

Fig.3.11: Casting of cubes

3.5.2 Preparation of Cylinder Specimens

At first, the water cement ratio and cement aggregate mass ratio was fixed as 0.45 and 1:1.99:3.68 as per mix design procedure. By these proportions,casted cylinders of size 100×200 mm for Splitting tensile strength test. All the casted cylinders are immersed in the curing tank for 7,14 and 28 days inorder to find the tensile strength

Fig.3.12: Casting of cylinder

3.5.3 Preparation of Working model

First setting a mould in the dimension of 15x20x3Cm,to attain the strength a cardboard is placed at the bottom of the mould.And holes are drilled on the cardboard by maintained the spacing of 2cm gap. And insert 1mm diameter POF into it, then poured the prepared concrete mix over it and after the curing period remove the excess POF and finish the surface

.

Fig.3.13: Setting of working model

Fig.3.14: placing of concrete

3.6 EXPERIMENTAL STUDY

3.6.1 Compressive strength Test

Compressive strength test, mechanical test measuring the maximum amount of compressive load a material can bear before fracturing. The test piece, usually in the form of a cube, prism, or cylinder, is compressed between the platens of a compression- testing machine by a gradually applied load. This test is allotted as per the rule given in IS 3495-1992. Compression test is that the main and vital test and this test was dispensed by a Compression Testing Machine. This test was carried out on the seventh, fourteenth and twenty eighth day from the day of casting. For most of the works cubical moulds of size 15cm x 15cm x 15cm are commonly used. This concrete is poured in the mould and appropriately tempered so as not to have any voids. After 24 hours, moulds are removed, and test specimens are put in water for curing. After the 28 days of curing the test specimen was removed from the water and the wet surfaces were wiped dry. After cleaning the bearing surface, the specimen was placed on the compression testing machine at the Centre of the base plate such that the load will be applied on the faces perpendicular to the cast face. The movable crosshead was made to touch the top surface of the cube, tightening it in place. The load was then applied continuously at the rate of 140 kg/cm2 per minute till the specimen failed. Record the maximum load and calculate the compressive strength of concrete cubes by following equation.

$$\text{Compressive strength} = \left(\frac{\text{Load}}{\text{Crosssectional area}}\right)$$

Fig.3.15 : Compression strength testing

3.6.2 SplittingtensileStrengthTest

The splitting tensile strength test is performed on hardened concrete to determine itstensile strength. Marginal variations in water to cement ratio, ingredient proportioning,increase in a slump, etc. impacts the desired concrete strength. This in turn affects thestrength and stability of structures. There are several tests to determine the strength ofconcrete. Quality tests are to be conducted on concrete at various stages starting from theproduction stage to the hardened stage, and on structures. Quality tests play an importantrole in ensuring the construction quality.

Fig.3.16:Splitting tensile strength test

3.5.3 Light transmittance Performance

Diffused natural light and sun light provide the frill spectrum of colors shining through the concrete panels. Sunlight is the most inexpensive light source. If the panel is mounted free standing or in front of a window, one will not need any artificial light source. Transparent concrete or translucent concrete is due to work based on "Nano-Optics". Optical fibers pass as much light when tiny slits are placed directly on top of each other when they are staggered. Optical fibers in the concrete act like the slits and carry the light across throughout the concrete.

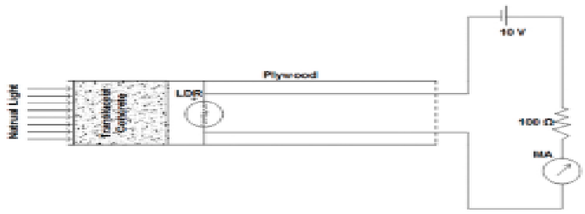


Fig.3.17: circuit setup for light transmittance test

Fig.3.18: LDR setup

RESULT AND DISCUSSIONS

The following values tabulated in the below table indicate the tests conducted on cement, values obtained, IS Specifications& allowable limit, and their Inference

Table 4.1 Properties of cement

SL.NO	Tests Conducted	Values Obtained	IS Specification and Allowable limit	Inference
1	Standard Consistency	27	IS;4013(PART 5) 1988,limit between 25%to35%	The obtained value is in between 25%-35%
2	Specific gravity	3.16	IS;4031-1988, Limit between 3.15-3.18	The obtained value is in between 3.15-3.18
3	Initial Setting Time	30 minutes	IS;4301-1968, Not less than 30 minutes	The obtained value is not less than 30 minutes

The following values tabulated in the below table indicate the tests conducted on Coarse aggregate ,values obtained, IS Specifications& allowable limit, and their Inference

Table 4.2 Properties of Coarse aggregate

SL.NO	Test Conducted	Results	IS specifiacation and allowable limit	Inferences
1	Specific gravity	2.8	According to IS 2386 (part IV)-1963 limit in between 2.6to 2.8	The obtained value is in between 2.6 to 2.8
2	Seive analysis	3.106	IS 383-1970 ,limit in between 3.1to 3.6	The obtained value is in between 2-3.5

The following values tabulated in the below table indicate the tests conducted on Fine aggregate, values obtained, IS Specifications& allowable limit, and their Inference

Table 4.3 Properties of Fine aggregate

Sl.No.	Test Conducted	Result	IS Specification & Allowable limit	Inference
1	Specific Gravity	2.66	IS;2386(part2)-1963 limit in between 2.65-2.67	The obtained value in between 2.65-2.67
2	Sieve Analysis	Fineness Modulus=3	IS;383-1970 limit in between 3.1-3.6	The obtained value in between 2-3.5

After 7,14&28 days of normal curing, a total no of 24 cubes of with and without POF were tested for compressive strength and 3 cylinders without POF were tested for Splitting tensile strength and the following values are tabulated in the below table

Table 4.4Compressive strength of Cubes without POF after 7 days of curing

SL.NO	Cubes size(cm)	Grade of concrete	Age of cubes in days	Compressive strength	Average
1	15×15×15	M30	7	26.53	
2	15×15×15	M30	7	24.43	25.54
3	15×15×15	M30	7	25.67	

Table 4.5 Compressive strength of Cubes without POF after 14 days of curing

SL.NO	Cubes size(cm)	Grade of concrete	Age of cubes in days	Compressive strength	Average
1	15×15×15	M30	14	31.45	
2	15×15×15	M30	14	30.40	30.84
3	15×15×15	M30	14	30.67	

Table 4.6 Compressive strength of Cubes without POF after 28 days of curing

SL.NO	Cubes size (cm)	Grade of concrete	Age of cubes in days	Compressive strength	Average
1	15×15×15	M30	28	37.82	
2	15×15×15	M30	28	35.38	36.69
3	15×15×15	M30	28	36.88	

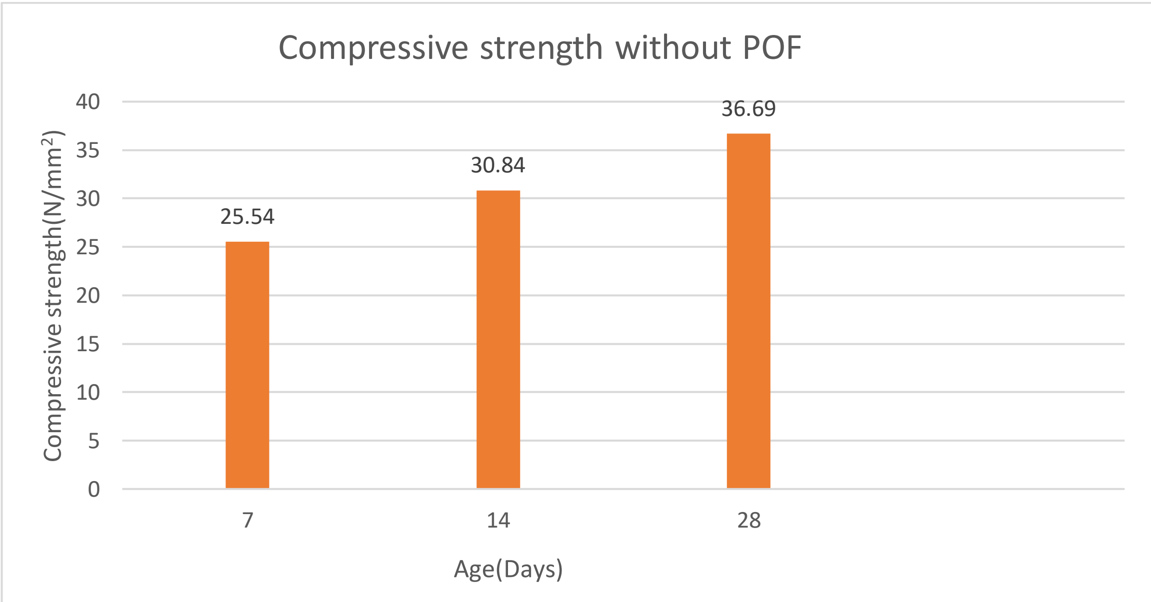


Table 4.7Compressive Strength of Cubes with POF after 7 days of curing

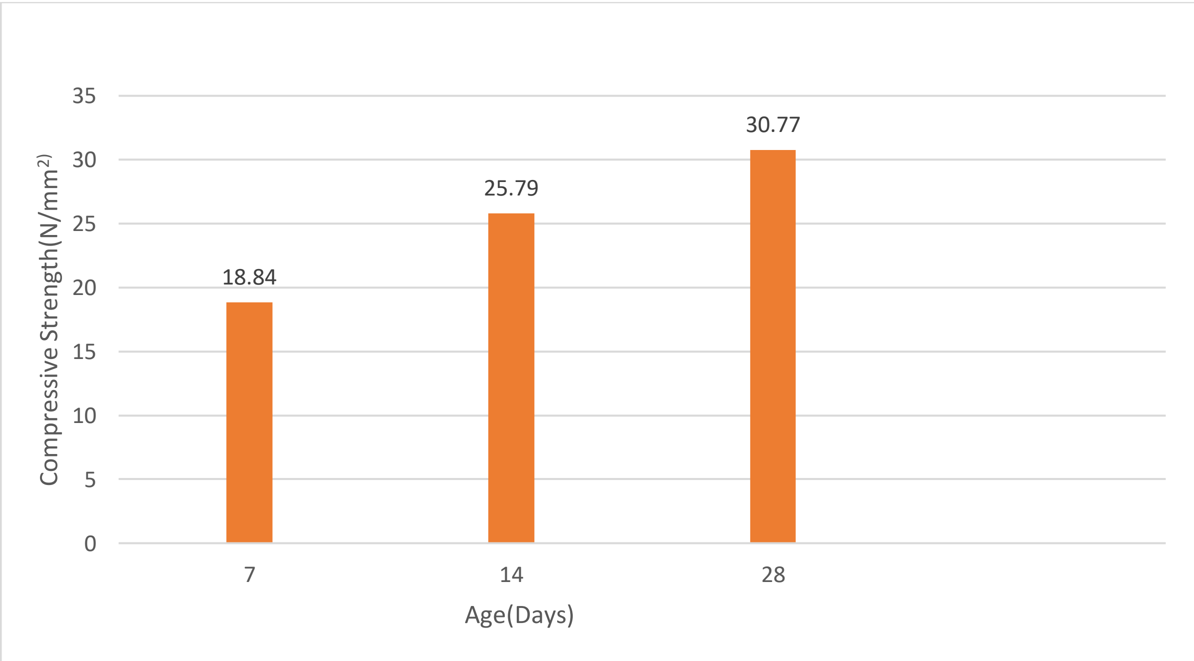
SL.NO	Cubes size(cm)	Grade of concrete	Age of cubes in days	Compressive strength	Average
1	15×15×15	M30	7	18.68	
2	15×15×15	M30	7	18.87	18.84
3	15×15×15	M30	7	18.98	

Table 4.8 Compressive Strength of Cubes with POF after 14 days of curing

SL.NO	Cubes size(cm)	Grade of concrete	Age of cubes in days	Compressive strength	Average
1	15×15×15	M30	14	25.43	
2	15×15×15	M30	14	25.64	25.79
3	15×15×15	M30	14	26.32	

Table 4.9 Compressive Strength of Cubes with POF after 28 days of curing

SL.NO	Cubes size(cm)	Grade of concrete	Age of cubes in days	Compressive strength	Average
1	15×15×15	M30	28	30.56	
2	15×15×15	M30	28	30.78	30.77
3	15×15×15	M30	28	30.98	



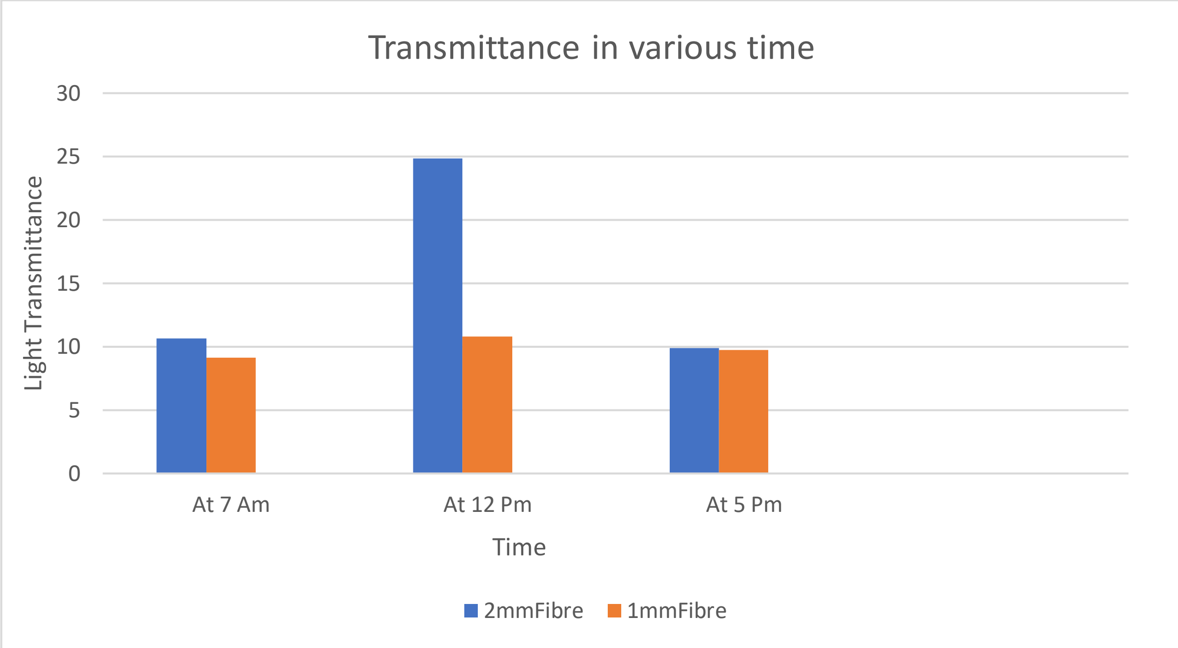
From the above graph it has been shown that translucent concrete can be also prepared using the normal concrete mix.so we can also implement the same properties of normal concrete on to the translucent concrete from these mix ratios finally we can conclude,it is possible to workout translucentconcrete. But it is more efficient to use slab size rather than cube size.After 28 days of curing the average compressive strength of conventional concrete is 36.69(N/mm^2), and translucent concrete is 30.77(N/mm^2).

Table 4.10 Splitting Tensile Strength Result

Sl.No.	7 Days (N/mm$^{2)}$	14 Days (N/mm$^{2)}$	28 Days (N/mm$^{2)}$
1	1.94	3.65	4.35
2	1.98	3.57	4.75
3	2.14	3.48	4.55
Average	2.02	3.56	4.55

Table 4.11Light Transmittance Test Result

Sample		Optical Fiber					
Area (Mm^2)		1 mm Dia Fiber 2 cm spacing	2 mm Dia Fiber 2 cm Spacing	1 mm Dia Fiber 2 cm spacing	2 mm Dia Fiber 2 cm Spacing	1 mm Dia Fiber 2 cm spacing	2 mm Dia Fiber 2 cm Spacing
		7AM		12 PM		5PM	
Ammeter Readings (Ma)	With Out Sample A1	9.74	11.63	9.74	11.63	9.74	11.63
	With Sample A2	.89	1.24	1.05	2.89	.95	1.15
Light transmittance 100 - $\frac{A1-A2}{A1}$ x100		**9.13**	**10.66**	**10.78**	**24.84**	**9.75**	**9.88**



From the above graph it has been shown that the light transmittance property of translucent concrete is more during day time. Diameter of POF increase, successive rate is also increases. here we compare 1mm and 2mm fiber for the test, the transparency of 2mm fiber is slightly higher than the 1mm fiber and also it reaches peak level at 12 Pm due to the high intensity of sunlight. During the night time the transparency is also possible due to the decorative light and other light agents.

CONCLUSIONS

In this study of Translucent concrete with POF were prepared and investigated the effect of POF on Conventional concrete, and the following conclusions are made

- Strength of the translucent concrete is inversely proportional to light transmittance.
- Translucent concrete can be also prepared using the normal concrete mix.so we can also implement the same properties of normal concrete on to the translucent concrete.
- After 28 days of curing the average compressive strength of conventional concrete is 36.20N/mm2, and translucent concrete is 30.83N/mm2.
- Light transmittance property of translucent concrete is more during day time. Here we compare 1mm and 2mm fiber for the test, the transparency of 2mm fiber is slightly higher than the 1mm fiber and also it reaches peak level at 12 Pm due to the high intensity of sunlight. During the night time the transparency is also possible due to the decorative light and other light agents.
- As the diameter of POF increases, the light transmittance rate is also increases.
- It is used for partition wall and decorative walls for the aesthetic beauty.But it is more efficient to use slab size rather than cube size.
- Itis not economical for small scale construction work because of the high cost of POF.

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