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Transparent Concrete (LiTraCon)

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Abstract:** This article 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. Light is conducted through the 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. It is used in fine architecture as a front of building material and for cladding of interior walls. 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 fibre 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 circumscribe 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 work presented in this project reports an investigation on the behaviour of concrete and mortar with optical fibre. Concrete and mortar cube are casted with fibers to study the properties and to compare the compressive strength between normal mix concrete with optical fibre and normal mortar with optical fibre after 7 days, 14 days and 28 days respectively. The compressive strength of concrete samples made with different fibre amount varies from 4% to 5% . The compressive strength of translucent concrete depends upon the amount of fibre content present. The samples with fibers of 4% showed better results in comparison with the others.

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I. INTRODUCTION

Today we are living in a world where energy outlay and environmental problems have magnify to global scale. Due to the increasing of population of the world wide every one want good facilities of lifestyle. Due to increase in population space utilization is more virtual factor, high rise buildings are constructing in big cities of the world, especially in those countries which have greater population and also gave a good economic condition. In high rise buildings it is a big problem of natural light in buildings due to the blockage of nearby structures. these causes the increasing the use of non-renewable energy sources To minimize this effect it is essential to use the material which will not block natural light into the buildings. so therefore there is a need of smart construction technique like green building and indoor thermal system. Transparent Concrete, with detailed discussion on developments of Transparent Concrete, their desired properties, their making procedure and applications, their behavior in use. Transparent concrete is 30% lighter than normal concrete and lets through some certain % of the light. It is available in the form of precast panels. It is use as a decorative material. Optical fibers are arranged in parallel form at outer side of the panel and light is transmit due to parallel arrangement. It can bear upto certain loads and fibers cannot decrease the strength. The panels are built in every size and shapes, surrounded with an isolation with a property of stopping heat. The concrete is embedded with thousands of optical glass fibers. These fibers form a matrix and run parallel between the two main surfaces. Excellent properties of light guiding and elasto-optics effect of optical fiber, a novel smart transparent concrete is researched by arranging the optical fibers into the concrete. To evaluate the effectiveness of the smart transparent concrete, the light guiding based on white light test, long-term durability based on compressive and thawing test and self-sensing property based on stress elasto-optics effect test are made respectively. The experiments results show that the smart transparent concrete has good strength with transparency, mechanical and self-sensing properties.

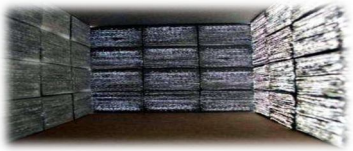


Fig.1

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II. MATERIAL USES

There are two basic materials used for making transparent concrete, one is from construction field and another from sensing field. First, concrete is one of the most important civil engineering materials with the advantages of rich raw materials, low cost and simple production process and second the optical fibre has good light guiding property which can be arrange to transmit the light and the sun light transmit.

GENERAL

A. Optical Fiber

Flexible transparent fiber made up of plastic. It transmits light between two ends of the fiber. Optical fiber transmits light so effectively that there is almost no loss of light conducted through the fibers. The thickness of optical fiber should be varied from 2 µm or nearly equal to diameter of human hair.



Fig.2

Talking about it's functional There is a physics behind it:

It has two parts :

1) *Core:* Central tube of very thin size made up of optical transparent dielectric medium and carries the light from transmitter to receiver. the core diametre can vary from about 5um to 100um.
2) *Cladding:* Outer optical material surrounding the core having reflecting index lower than core, it helps to keep the light within the core throughout the phenomena of internal reflection

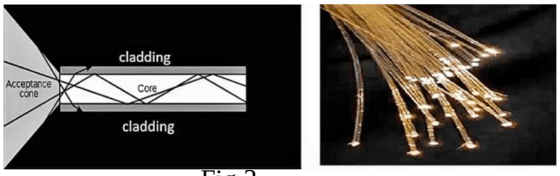


Fig.3

Three kinds of optical

a) Multimode graded-index fiber
b) Multimode mode step-index fiber
c) Single mode step-index fiber

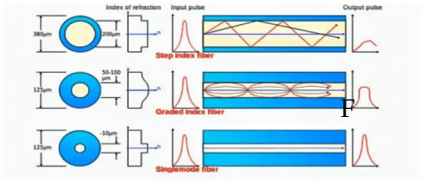


Fig.4

B. Cement

Ordinary Portland Cement (OPC) 53 Grade which surpasses the requirements of IS12269-1987 Grade. It is produced by inter grinding of high grade clinker (with high C3S content) and right quality gypsum in predetermined proportions. It is recognized for its high early strength and excellent ultimate strength because of its optimum particle size distribution, superior crystalline structure and balanced phase composition and hence widely used and suitable for speedy construction, durable concrete and economic concrete mix designs.

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Best advantage for superior quality ensures substantial savings in cement consumption, Development of very high compressive strength in early stages helps in early de-shuttering, Superior resistance to sulphate attack due to less C3A content, Durable Concrete, Feasible for economical concrete mix designs, Low percentage of alkalies, chlorides, magnesia and free lime results in longer life of concrete structures.

C. Sand

Sand is naturally available material which is composed rock and mineral particles. Size of sand should pass through 1.18mm sieve. It should be free from impurities and organic matters.

D. 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. Fundamentally the strength of concrete is governed by the nature of the weight of water to the weight of cement in a mix, provided that it is plastic and workable, fully compacted, and adequately cured.

E. Aggregate

Aggregates were first considered to simply be filler for concrete to reduce the amount of cement required. However, it is now known that the type of aggregate used for concrete can have considerable effects on the plastic and hardened state properties of concrete. They can form 80% of the concrete mix so their properties are crucial to the properties of concrete. Aggregates can be broadly classified into four different categories: these are heavyweight, normal weight lightweight and ultra-lightweight aggregates.

III. MATERIAL SPECIFICATION

The basic material used for manufacture of transparent concrete are cement, aggregate and optical fibre. Table:1 shows the important specifications of this materials

Sr.	Material	Specification
1.	Cement	OPC 53
2.	Course aggregate	4.75 mm
3.	Fine aggregate	1.18mmcpass
4.	Concrete grade	15 (1:2:4)
5.	Optical fiber	Upto 4%-5% of replace course aggregate

A. Properties of Materials

1) Cement: Ordinary Portland cement was used for casting all the specimens. The important features required in translucent concrete are shown in Table

Table 1.1 Properties of Cement

Sr.	Properties of Cement	Values obtained
1	Fineness of cement as retained on 90 micron sieve	3%
2	Grade of cement	53
3	Specific Gravity	3.15
4	Initial Setting time	30min

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2) *Fine Aggregate:* Clean and dry river sand available locally is used. Sand passing through IS 1.18 mm Sieve is used for casting all the specimens. The values of specific gravity and fineness modulus are shown in Table

Table 1.2 :Properties of Fine Aggregate

Sr.	Properties	Values obtained
1	Specific Gravity	2.53
2	Fineness Modulus	1.18

3) *Coarse Aggregate:* Through 4.75 mm sieve is used for casting all specimens. Table 2.2.2.3 indicatesthe important values of properties of coarse aggregate

Table 1.3 : Properties of course Aggregate water

Sr.	Properties	Values
1	Size of Aggregates	4.75mm
2	Fineness Modulus	5.01
3	Specific Gravity	2.35

4) *Water:* Ordinary potable water of normally pH 7 is used for mixing and curing the concrete specimen .

IV. METHODOLOGY

The manufacturing process of transparent concrete cube same as normal concrete cube.

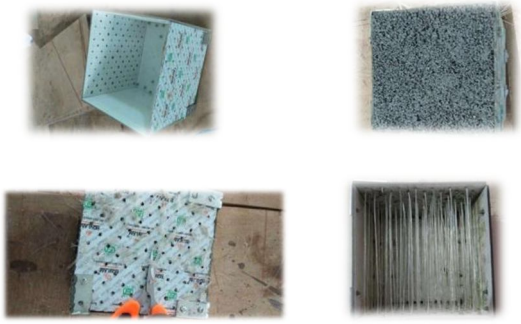


Fig.5

1) First step to make a mould using electric circuit bord of desired shape like a regular cube.
2) Then hole are punched on that plate and optical fibers are made to pass through it on both ends.
3) Then mixing of concrete process occur. The concrete we are useing it is M15 grade of concrete which is ratio (1:2:4).
4) Quantity of cement 1.1kg, sand 2.3kg, Aggregate 4.6kg, Fiber 0.23kg.(5%).
5) Then the concrete is poured into the mould.
6) The concrete then under goes the curing process
7) Then after the 24hr. the excess of fiber is cut and de mould it then polishing is done on the material.

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Output



Fig.6

Name	LiTaCon
Form	Prefabricated
Ingredients	95% con., 5%(0.345kg)pof
Grade	M15(1:2:4)
Density	1789-1800 kg/m^3
Maximum block size	150 x 150
Standard block size	150 x 150
Colour	gray
Weight	6.67Kg

A. Properties of Translucent Concrete

Transparent concrete is produced out of fine-grain concrete and translucent fabric which is layer cast in pre-fabricated mould. Because of relatively small amount of fabric, solidity and consistency of transparent concrete are the same as the high-strength concrete. Almost free energy loss light penetration through optic fibres makes it possible to see light, shadows and even colours through concrete even by very thick walls. It can be produced as prefabricated building blocks and panels. Due to the small size of the fibres, they blend into concrete becoming a component of the material like small pieces of aggregate. In this manner, the result is not mixed material like glass in concrete but a new material, which is homogeneous in its inner structure as well as on its main surfaces. The optical fibres lead light by points between the two sides of the blocks. Because of their parallel position, the light-information on the brighter side of such a wall appears unchanged on the darker side. The most interesting form of this phenomenon is probably the sharp display of shadows on the opposing side of the wall. Moreover, the colour of the light also remains the same.

V. TEST PROCEDURE

The first part of this study focused on testing previous concrete mix designs to see which would yield the optimal compressive strength and compare with conventional concrete.

A. Compressive Strength

7Ddays, 14days and 28-day compressive strength tests were performed in accordance with ASTM C39, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens. The previous concrete samples were capped with neoprene pads before being placed in the loading frame for testing as billow figure. An example of a failed sample ispresented in the billow figure. A total of 3 samples were used for the strength test.

Load Measurement



Test mode Damage mode

From the test result it is observed that compressive strength gain for 7,14and 28days with optical fiber is 8.88N/mm2, 11.45N/mm2, 12.8N/mm2 respectivly.

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VI. COMPARISON

The compressive strength of concrete cube with and without Optical fibers has been calculated for 3, 14and 28 days . From the test result it is observed that compressive strength for 3,7and 28days with optical fiber is 8.88N/mm2, 11.45N/mm2, 12.8N/mm2 respectivly. That for conventional concrete is 9.56N/mm2, 13.02N/mm2, 15.24N/mm2 respectivly.

Days	With fiber	Without fiber /Conventional concrete
7days	8.88N/mm2	9.56N/mm2
14days	11.45N/mm2	13.02N/mm2
28days	12.8N/mm2	15.24N/mm2

The quantity of **material** use in concrete cube with and with out fiber has calculated 1.1kg cement, 2.3kg sand, 4.37kg and 0.23kg fiber aggregate where for a normal M15 cube need 1.1kg cement, 2.3kg sand, 4.6kg Aggregate.

Material	Normal cube	Translucent Cube
Cement	1.15Kg	1.1Kg
Sand	2.3Kg	2.3Kg
Aggregate	4.6Kg	4.37Kg
fiber	X	0.23Kg

VII. APPLICATION

The main advantage of transparent concrete is that it can transmit light. There, it can be used to make green buildings. Since it can transmit light from natural as well as artificial sources, the building can have fewer lights to meet its demand for lighting. Thus saving huge energy cost.

It can be also applicable at:

1) Transparent concrete blocks suitable for floors, pavements and load-bearing walls.
2) Facades, interior wall cladding and dividing walls based on thin panels.
3) Partitions wall and it can be used where the sunlight does not reach properly.
4) In furniture for the decorative and aesthetic purpose.
5) Increasing visibility in dark subway stations power failure & Illuminating speed bumps on roadways at nigh

A. Advantages And Disadvantages

The main advantage of these products is that on large scale objects the texture is still visible - while the texture of finer translucent concrete becomes indistinct at distance.

1) When a solid wall is imbued with the ability to transmit light, it means that a home can use fewer lights in their house during daylight hours.
2) It has very good architectural properties for giving good aesthetical view to the building.
3) Where light is not able to come properly at that place transparent concrete can be used.
4) Energy saving can be done by utilization of transparent concrete in building.
5) Totally environment friendly because of its light transmitting characteristics, so energy consumption can be reduced.
6) The main disadvantage is these concrete is very costly because of the optical fibres.
7) Casting of transparent concrete block is difficult for the labour so special skilled person is required.

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VIII. CONCLUSION

The project was mainly focused on the smart construction technique like green building and indoor aesthetic system.

Research may be conducted on other properties and uses of glass dust powder, rubber to provide a higher strength to structure in the near future to make this a precious building material to improve the quality of building construction industry in technology, manufacturers and as well as the users. Translucent concrete is the future. It is the smart way of optimizing and utilizing light, a smart way of living. Light transmtting concrete is an emerging trend in concrete technology. its initial cost is high . but, routine maintenance is not required and in long run it may be advantagious. it's a green building material reducing the lighting cost during day time. it's proved to provide both astetic appearance and structural stability. in future the it's cost is expected to decrease. it is the one of the best application of optical glass fibers which is related to technical textiles.

1) It is concluded that, on usage of 4%/5% of optical fibers the compressive strength increased. The compressive strength of concrete cube depends on diameter of the holes in the mould and the diameter of the optical fibre and it is directly proportion to its compressive strength .

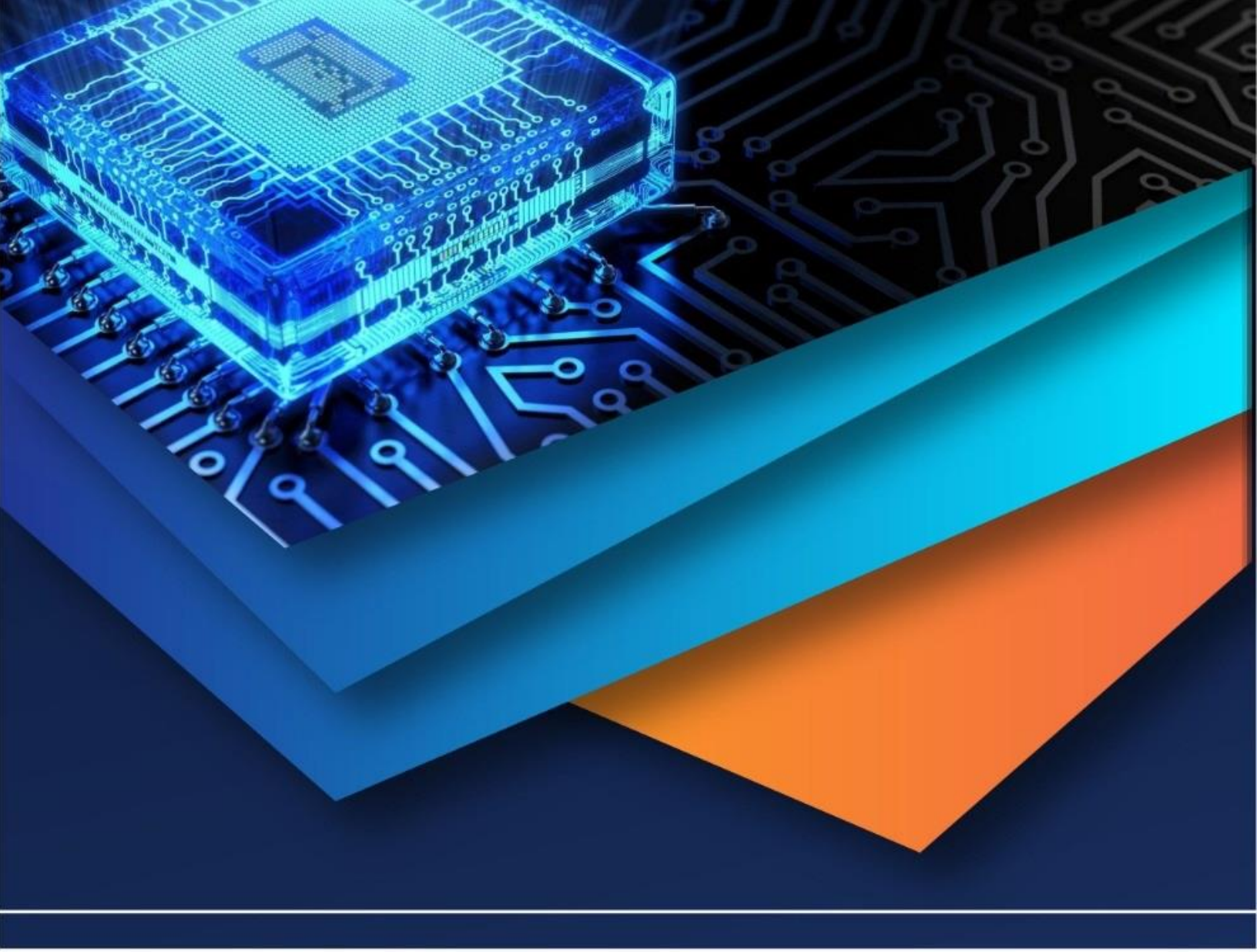
2) The compressive strength of Light Transmitting Concrete was found to be ranging between 10N/mm2-14N/mm2 with optical fibre satisfies the compressive strength requirement for M15 or goes upto M20 grade concrete. The study concludes that the transparency of light is possible in concrete without affecting its compressive strength, as the optical fibres act as fibre reinforcement thereby enhancing the strength and also enhances appearance.

3) The amount of POFs has seriously influenced the compressive strength of the corresponding concrete. The much number the POFs are, the smaller the compressive strength is. So the transmissions cannot endless increase by way of endless increasing the number of POFs in concrete. Furthermore, the POFs have also reduced the anti-permeability of the concrete. Using the epoxy resin to seal the boundary of POFs and concrete, the smart transparent concrete's anti-permeability can be greatly improved

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