

# An Experimental Investigation on Energy Efficient Lightweight Light Translucent Concrete

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**Abstract**— Lightweight concrete is one of the advanced concrete which is used to reduce the self-weight of the concrete. This is lighter than conventional concrete. Its main speciality is its low density and thermal conductivity. The main advantages of light weight concrete are reduction in dead weight, faster building rate in construction, lower haulage, handling cost. Light translucent concrete is one of the fibre reinforced concrete which is used for aesthetic application by incorporating the optical fibres in concrete. An optical fiber (or optical fiber) is a flexible, transparent fiber made of glass (silica) or plastic, slightly thicker than a human hair. It can function as waveguide, or “light pipe” to transmit light between the two ends of the fiber. Our project deals with light weight light translucent concrete, in which coir pith is used partially instead of sand to reduce its self-weight. In Tamil Nadu and Kerala the availability of coconut is high so we used it as an additional material. Optical fibres are one which helps for transmission of light through fibre. And we are not using coarse aggregate due to light transmitting concrete. so this type of concrete brings more advantage in smart construction.

**Key words:** Light Transmitting Concrete, Optical Fibre, Transparent Concrete, Coir Pith, Admixture

## I. INTRODUCTION

Lightweight LiTraCon (“Lightweight light transmitting concrete”) is a lightweight translucent concrete building material made of fine concrete embedded with 5% by weight of optical glass fibres. Light transmitting was developed in 2001 by Hungarian architect Ron Losonczy working with scientists at the Technical University of Budapest. Light Litracon presents the concept of light transmitting concrete and Lightweight in the form of a widely applicable new building material. It can be used for interior or exterior walls, illuminated pavements or even in art or design objects. By impregnating the concrete with optical glass fibres, light can be transmitted from the outside in or inside out.

A wall made of “Light LitraCon” has the strength of traditional concrete and an embedded array of glass fibres that can display a view of the outside world, such as the silhouette of a tree, for example. Thousands of optical glass fibres form a matrix and run parallel to each other between the two main surfaces of every block. Shadows on the lighter side will appear with sharp outlines on the darker one. This special effect creates the general impression that the thickness and weight of a concrete wall will disappear. The hope is that the new material will transform the interior appearance of concrete buildings by making them feel light and airy rather than dark and heavy.

## II. LITERATURE STUDY

A. Zhi Zhou et al (2006), reported that the light guiding performance of concrete materials is completely determined by the internal POFs area ratio and the surface roughness in certain sections. POF based transparent concrete could be regarded as an art which could be used in museums and specific exhibitions rather than just a construction material. Jianping He et al (2011), studied the excellent properties of light guiding and elasto-optic effect of optical fibre. To evaluate the effectiveness of smart transparent concrete and they concluded the transparent concrete has good light guiding property, and the POF volume ratio to concrete is proportion to transmission. The amount of POFs has seriously influenced the compressive strength of the corresponding concrete. The POFs have reduced the anti-permeability of the concrete. Varsharina et al (2013), investigated to develop the building aesthetic in modern construction and consumption of energy with eco-friendly way. The main purpose is to use sunlight as a light source to reduce the power consumption of illumination and to use the optical fibre to sense the stress of structures and also this concrete as an architectural purpose for good aesthetical view of the building. This kind of building material can integrate the concept of green energy saving with the usage self-sensing properties of functional material. Basma F. Bashbash et al (2013), discussed about the development of a light transmitting concrete using plastic optical fibre, which will help to reduce the consumption of electric energy. They concluded that an optical fibre can be easily combined with concrete and that the POF could provide a steady light transmitting ratio. The smart transparent concrete can be regarded as a green energy saving construction material.

B. P. RONALD ROSS, ISSN 2249-9695 International Journal of Research in Environmental Science and Technology reported the physico-chemical properties of coir pith in relation to particle size suitable for potting medium. Coir pith, light to dark brown in colour, consists primarily of particles in the size range 0.2–4 mm. The physico-chemical properties of coir pith was investigated after grading it based on particle size (100µm to 2000µm) for the use as potting medium. The porosity, density and absorptivity decreased as the particle size increased. Ph of raw coir pith was found to be acidic in nature but as the particle size increased, the pH also became alkaline. The electrical conductivity was observed to be high in lower grades of coir pith (4.41 mS / cm) which gradually decreased as the size increased (3.32 mS / cm). The salt analysis made on coir pith did not show any significant change according to particle size. But potassium, sodium, nitrite, calcium and chloride ions were found to be decreasing in amount considerably

as the particle size increased while the phosphorous, nitrate and TOC were found to be almost constant or slightly varying. Thus we conclude that the smaller particle size of coir pith (100-750µm) is more suitable for potting medium than the larger size (1500-2000µm).

### III. SIGNIFICANCE OF THE STUDY

- 1) To make the concrete decorative by luminating on the surface
- 2) Reduce the dead weight of the structure.
- 3) To check whether the introduction of fiber wire into concrete will help or influence to change in the engineering properties of the member.

### IV. EXPERIMENTAL INVESTIGATION

#### A. Materials Used:

Portland Pozzolana cement, Natural sand, Coir Pith, Water, Admixture and Optical fibre.



Fig. 1: Coir Pith

#### B. Mix Proportions:

To achieve the strength of 20 Mpa the quantity of materials arrived as

Cement –364 kg, Sand – 655.2 kg,

Coir pith – 436.8 kg, Water – 182 lit

Quantity of fibre required =  $(182 + 364 + 1092) \times (0.4/100)$   
= 6.6 kg

Cement (kg)	Fine Aggregate (kg)	Natural Sand (kg)	Coir Pith (kg)	Fibre (kg)	Water (kg)
364	1092	655.2	436.8	6.6	182
1	3	60%	40%	0.4%	0.5

Table 1: Mix Proportions of Lightweight Litracon

Volume Based Method. We Used 1:3 Ratios.

1% of Cement 3% of Fine Aggregate.

In 3%, 60% - River Sand, 40% - Coir Pith

Water should be calculated based on the volume of cube.

To increase its proportion, we used volume based method. To increase its binding nature we used chemical called "ROFF (bond repair). 4 to 5 % - Optical fibre in total volume of the cube

#### C. Workability:

The workability of the concrete is determined by conducting the slump cone test.

#### D. Compressive Strength:

By definition, the compressive strength of a material is that value of uniaxial compressive stress reached when the material fails completely.

The compressive strength is usually obtained experimentally by means of a compressive test. The compressive strength of the concrete is determined by cast the cubes of size 100mm x100mm x100mm.

Compressive strength = load/area

#### E. Flexural Strength:

The flexural strength of the concrete is determined by conducting the test on prism by two points loading.

Flexural strength =  $Pl/bd^2$

Where,

- P – Load,
- l – Length of the specimen
- b - width of the prism
- d – depth of the prism

### V. RESULTS AND DISCUSSIONS

#### A. Workability:

The workability of the concrete is determined by conducting the slump cone test and the observed slump is 90mm.

#### B. Compressive Strength (Weight Based):

The below table shows the compressive strength of different percentage as 10-20 % replacement of coir pith instead of fine aggregate It is calculated for Total Volume of  $100 \times 100 \times 100 = 1 \times 10^6 \text{ mm}^3$

%	DAYS	3	7	28
10 %		4	2.826	5.181
15 %		2.259	2.853	3.681
20 %		1.521	1.93	1.4

Table 2:

Note \*: All the values mentioned in N/mm2

#### C. Weight of the Cube:

(Total Volume -  $100 \times 100 \times 100 = 1 \times 10^6 \text{ mm}^3$ )

10 % Replacement of Coir Pith: 1692.5 g

15 % Replacement of Coir Pith: 1553.5 g

20 % Replacement of Coir Pith: 1465.5 g

#### D. Compressive Strength (Volume Based):

The compressive strength of the conventional concrete and light transmitting concrete in 7, 14 and 28 days is shown in Figure1.

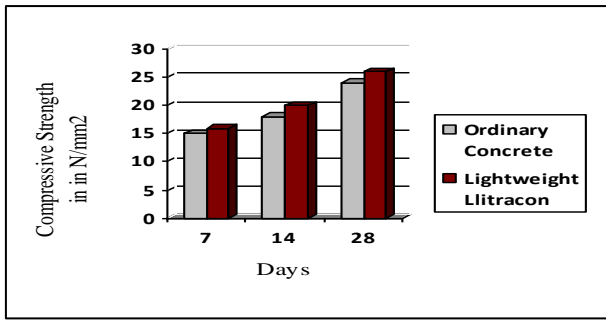


Fig. 2: Compressive Strength of the Concrete

E. Flexural Strength:

- 1) The flexural strength of the conventional concrete and light transmitting concrete in 7, 14 and 28 days is shown in Figure 2.

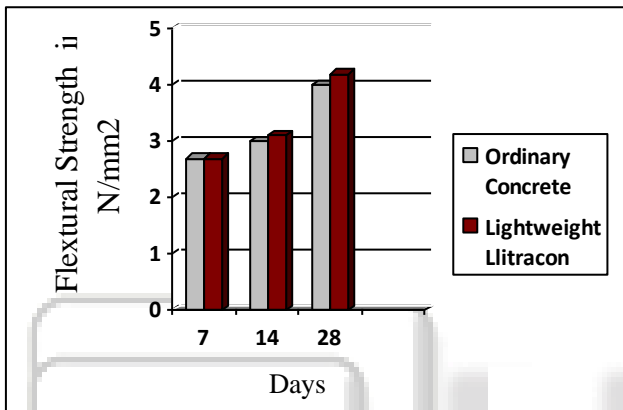


Fig. 2: Flexural Strength of the Concrete

- 2) The strength results of decorative concrete are correlated with results of ordinary plain cement concrete.
- 3) The results evidently show that the decorative concrete also performance based on the strength aspect is also considerably high.
- 4) Hence the application of optical fibre will make the concrete decorative as well as can make the concrete structural efficient.

F. Comparison of Weight:

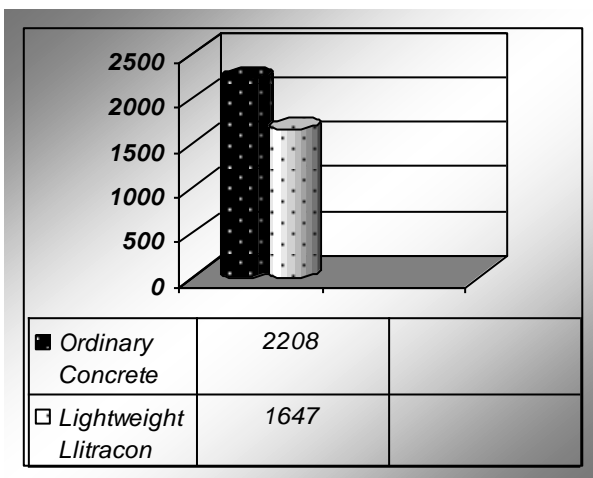


Fig. 3: Comparison of Weight in Gram

Our project mainly Focus Light Transmitting and Lightweight also. We compared our 100X100X100mm Normal cube weight with Lightweight cube. It gives nearly 500g Difference in 100X100X100mm Cube.

G. Appearance of Lightweight Litracon:

1) Decorative Aspect:

This decorative concrete can be used in interior design of buildings as panels in slabs, walls etc. The decorative concrete can be used in place of windows because it can transmit the sunlight.



Fig. 4: Lightweight Light Translucent Concrete

VI. CONCLUSION

- 1) The efficiency of the application of optical fibre 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.
- 2) The fibres can be used in concrete for decorative purpose also lightweight is applicable for site.
- 3) The major purpose of light transmitting concrete is created as a model and the light transmission is made of the illuminating side of the concrete.
- 4) The main advantage of lightweight is reducing the self-weight of the structure.
- 5) This decorative concrete can be used in interior design of buildings as panels in slabs, walls etc.
- 6) The decorative concrete can be used in place of windows because it can transmit the sunlight.
- 7) Hence the application of optical fibre will make the concrete decorative as well as can make the concrete structural efficient.
- 8) Thus, the final appearance of light weight litracon is shown in figure 4.

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