EXPERIMENTAL INVESTIGATION AND COST ANALYSIS OF LIGHT TRANSMITTING CONCRETE

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ABSTRACT

Light transmitting concrete, known as LiTraCon concrete, is literally the brightest concrete development in recent years. Strands of optical fibers are cast by the thousands into concrete to transmit light, either natural or artificial, into all spaces surrounding the resulting translucent panels. The main theme of this project is use optical fibers in concrete, which is energy saving and green technology. It lends great energy saving in closed and non-ventilated spaces. Due to small size of the fibers, they blend into concrete becoming a component of the material like small pieces of aggregate. By using plastic optical fibers in concrete specimens, light transmission occurs through optical fibers, which make it possible to see light, shades and even colors through very thick walls. The test results showed that light transmitting concrete did not have much reduction in strength parameter when compared to conventional concrete. The present investigation aims at producing the concrete specimen by using plastic optical fiber and comparing it with conventional concrete. Different tests are carried out the concrete specimen like compressive strength test and light transmitting test. The cost of the light transmitting concrete is compared to the conventional concrete.

INTRODUCTION

Light transmitting concrete (LTC) , developed in 2001 by Hungerian architect RonLonosonzi at the technical University of Budapest was first of its kind. And the first transparent concrete block is successfully produced by mixing of large amount of glass fiber into concrete in 2003,and named as LiTraCon. It presents the concept of light transmitting concrete in the form of a widely applicable new building material. The Italian pavilion at shangai World Expo 2010 recognized as the first significant application of transulant concrete in building. It is also known as “LiTraCon” or Transulant concrete. The Al-Aziz Mosque in Abu Dhabi is an example of a newly constructed building which uses light transmitting technology.

OBJECTIVES OF STUDY

- The main objective of the project is to create an extravagant concrete and to provide aesthetic appearance to the conventional concrete by the use of optical fibers.
- To compare the strength of light transmitting concrete to the conventional concrete.
- To compare the cost analysis of conventional concrete and light transmitting concrete.

BENEFITS OF OPTICAL FIBER

- Safe – no electricity needed
- Economical
- Versatile – multiple application are possible from one light source
- User friendly

MATERIALS USED

A. Cement:

A fine substance made with calcined lime and dirt. It is blended with water and sand to frame mortar and blended with sand, rock, and water to make concrete. In assembling of Concrete shapes and barrels OPC – 43 was utilized

B.Fine aggregate:

Aggregates are the major and important constituents of concrete. They form the whole body of the concrete as it occupies 70-80% of the volume ofconcrete. Fine aggregate is sand which is usually obtained from rivers or lakes. Some times beach sand also used. In this project we use river sand.

C. Coarse Aggregate:

The aggregates used for production of Concrete is free from sound and honeycombed practices. Those particles that are predominantly retained on the 4.75mm I.S Sieve are called coarse aggregate.The nominal size of coarse aggregate with 20mm is used in this work.

D. Optical Fiber:

Optical fiber is flexible and transparent fibers made of a pure glass (silica), It functions as a waveguide, or light pipe, to transmit light between the two ends of the fiber. Genarally 1mm diameter stands are used for contruction of translucent concrete.

A) CEMENT

B) OPTICAL FIBER

C) COARSE AGGREGATE

MATERIAL TESTING

A. SPECIFIC GRAVITY TEST:

The Specific gravity of the aggregates that are used is tested by following the Indian Standards specification by following IS 2386 (Part III) – 1963**.** The pycnometer is thoroughly cleaned and dried, its empty weight is taken (W1). Take about 150g of dry soil & put it in the bottle and find its weight (W2). The density bottle is filled with water up to the mark & its weight as (W3). The bottle is now emptied completely fill with water up to the mark & its weight (W4).

B. SIEVE ANALYSIS TEST

Sieve analysis is done for fine aggregate course aggregate as per IS 2386 (Part I)-1963. Take suitable quantity (1000gms) of oven dried soil retained in 75µ sieve. Sieve the soil through 4.75mm, 2.36mm, 1.18mm, 1mm, 600µ, 300µ, 150µ and pan using a mechanical sieve shaker for 2 minutes. The course aggregate retained through 80mm, 40mm, 20mm, 10mm, 4,75mm, 2.36mm, 1.18mm, 600µ and pan shaking for few minute. Each sieve and pan with soil retained on them is weighted carefully and note it in observation. The sum of the retained soil is checked against the original mass of soil taken.

C. WATER ABSORPTION TEST

The example ought to be altogether washed to expel better particles and clean, depleted and then put in the wire bushel and submerged inwater at temperaturebetween 220c – 320c. The crate and test ought to remain submerged for a time of 24 hrs. The totals ought to be spread on the fabric and presented to the air far from coordinate daylight till it gives off an impression of being totally surface dry. The total ought to be weighted at A. The total should then be put in a stove at a temperature of 1000 to 1100 c for 24hrs. It ought to be expelled from the stove, cooled and weighted at B.

MIX PROPORTIONS

mix proportions are arrived as follows for $1m^3$: cement –1.32kg, fine aggregate-3.62kg, course aggregate-2.15kg,fiber-0.03kg, water-0.668lit.

EXPERIMENTAL PROGRAMME

Testing of hardened concrete plays as important role in controlling and confirming the quality of cement concrete works.

TESTS ON HARDENED CONCRETE

A. COMPRESSIVE STRENGTH TEST

By definition, the compressive strength of material is that value of axial compressive stress reached when the material fails completely. The compressive strength is usually obtained experimentally by means of compressive test. The compressive strength of concrete is determined by cast the cubes of 150mm x 150mm x 150mm. It is the most important test for concrete, tests was done according to ASTM. The compressive strength based on the average of three cubes which are 7 days 14days and 28days of curing of light transmitting concrete and conventional concrete. Place the case in the machine in such a path, to the point that the stack may be associated with the opposite sides of the strong shape cast. Adjust the example halfway on the base plate of the machine. Apply the

heap bit by bit without stun and constantly till the example falls flat. Record the most extreme load and note any abnormal highlights in the sort of disappointment.

B. LIGHT TRANSMITTING TEST

Various light measuring equipements is available such as lux meter, optical meter, etc., however a simple Lux meter can be made in laboratory using simple components. The light transmittance through the sample can be measured by measuring the current corresponding to the light which can be measured by a photo diode or a Light Dependent Resistors (LDR). The use of photo diode would require a separate sensor which would increase the cost. The most adaptive choice would be LDR are soldered onto a PCB board. The LDR measures the light transmitted through the sample and converts it into the current, which in this case is measured in mili amperes (mA). So, two readingare taken one without sample (A1) and one with sample (A2). The source of light here is taken as 60w sodium bulb. A resistance of 100ohm is applied in the circuit and a uniform DC voltage of 2.5V is kept between the circuits. To ensure no light escape throughout the test, a box made up of palywood is used. The light source is fixed at one end of the box and LDR is placed another end. The sample is placed between source and LDR and the test is carried out.

RESULT AND DISCUSSION

COMPRESSIVE STRENGTH TEST

CONVENTIONAL CONCRETE

The compressive strength of conventional concrete was then determined by using compressive testing machine after 7days 14days and 28 days of curing and the results are given below.

Days	Maximum load (kN)	Compressive strength (N/mm^2)	Average
7	438.6	19.49	18.27
	407	18.09	
	387.7	17.23	
14	581.4	25.84	24.45
	523.8	23.28	
	545.2	24.23	
28	768.7	34.16	36.3
	832.5	37	
	849.2	37.74	

LIGHT TRANSMITTING CONCRETE

Days	Maximum Load (kN)	Compressive Strength (N/mm^2)	average
7	407.7	18.12	19.54
	490.4	21.79	
	420	18.71	
14	515.7	22.92	25.82
	600	26.67	
	627.1	27.87	
28	887.8	39.46	36.66
	727.1	32.31	
	859.6	38.20	

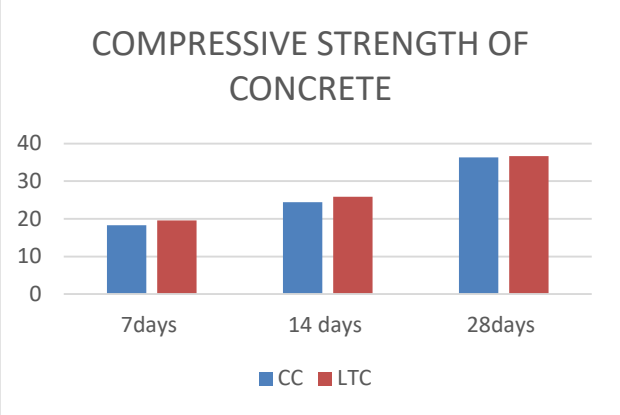

Fig. graph of compressive strength test

LIGHT TRANSMITTING TEST

samples		Test specimens		
		1	2	3
Ammeter readings (mA)	Without sample (A1)	3	3	3
	With sample (A2)	0.2	0.19	0.17
Light transmittance 100- (A2-A1)/ A1 x100		6.6 %	6.3%	5.6%

COST ANALYSIS

The cost of material for light transmitting concrete and conventional concrete are compared.

CONVENTIONAL CONCRETE

material	**weight (kg)**	**Rate (Rs/kg)**	**unit**	**Amount (Rs)**
Cement	11.88	(350rs/bag)	kg	83.16
Fine Agg.	32.58	(5000rs/ton)	Cu.m	162.9
Coarse Agg.	19.35	(350rs/ton)	Cu.m	6.75
Water	5.985	10rs/lit	lit	59.85
			Total	313

LIGHT TRANSMITTING CONCRETE

material	**weight (kg)**	**Rate (Rs/kg)**	**unit**	**Amount (Rs)**
Cement	11.88	(350rs/bag)	kg	15.84
Fine Agg.	32.25	(5000rs/ton)	Cu.m	161.25
Coarse Agg.	19.35	(350rs/ton)	Cu.m	6.75
Water	5.985	10	lit	59.85
optical fibre	0.325	(850rs/kg)	kg	276.25

			Total	520

The cost of light transmitting concrete is slightly more than the conventional concrete. But at day time the light transmitting concrete reduces lighting cost, also it reduce the electricity usage of day time. It provides both good aesthetic and structural stability. In large and tall buildings can share the lighting when the ceiling are transparent or translucent. It reduces the day time usage of lights. So it becomes advantages.

CONCLUSION

After the experimental investigation, the following conclusions can be made

- The compressive strength of light transmitting concrete was found to be ranging between 30-37 N/mm^2 with plastic optical fibre specimen, which indicates that the concrete meets the compressive strength requirement for building structures.
- The light transmittance for the 28days curing sample was found to be 5-7% for plastic optical fibre specimens.
- The initial cost of light transmitting concrete is slightly more than the conventional concrete. But the day time electricity usage is reduced by the usage of light transmitting concrete.
- Thus the study concludes that the transparency of light is possible in concrete without affecting its compressive strength, as the plastic optical fibre act as reinforcement thereby enhancing the strength and also enhances appearance.

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