



Properties of Concrete Cube by Using Optical Fibers

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Abstract—The concrete currently used in the construction industry generally consists of at least cement, water and aggregates (fine or coarse). Traditional concrete has a greyish colour, and its high density prevents the passage of light through it, which means that it is also impossible to distinguish bodies, colours and shapes through it. As can be imagined, concrete with the characteristic of being translucent will permit a better interaction between the construction and its environment, thereby creating ambiances that are better and more naturally lit. Along with the translucent characteristics, the paper also confides its area towards the reinforcement method of this type of concrete such that they can be practically implemented as a load bearing structure. This new kind of building material can integrate the concept of green energy saving with the usage self-sensing properties of functional materials.

Transparent concrete is a concrete based building material with light-Trans missive properties due to embedded light optical elements usually Optical fibers. Light is conducted through the concrete from one end to the other. Therefore the fibers have to go through the whole object. Transparent concrete is also known as the translucent concrete and light transmitting concrete because of its properties.

Index Terms—optical fibers, translucent concrete, green building transparent concrete

I. INTRODUCTION

The term “Translucent Concrete” has the potential to be somewhat misleading. The concrete itself is not translucent, nor is it any different to conventional concrete. This product also contains glass fiber optics which has the capacity to communicate light frequencies. Perhaps a more suitable term could be “light transmitting concrete”. In 2001, the concept of transparent concrete was first put forward by Hungarian architect AronLosonzi, and the first transparent concrete block was successfully produced by mixing large amount of glass fiber into concrete. In 2003, named as LiTraCon. Joel S. and Sergio O.G. developed a transparent concrete material, which can allow 80% light through and only 30% of weight of common concrete. It is worth mentioning that Italian Pavilion in Shanghai Expo 2010 showed a kind of transparent concrete developed by mixing glass into concrete in 2010. While the transparent concrete mainly focuses on transparency and its objective of application pertains to green technology and artistic finish. Therefore it is imperative to develop a new functional material to

satisfy the structure in terms of safety monitoring (such as damage detection, fire warning), environmental protection and energy saving and artistic modeling. Transparent or translucent concrete can be seen as a recent answer to the architects call for more Transparent Architecture.

Present paper attempts at producing a concrete that has light transmitting properties as well is structurally strong.

II. EXPERIMENTAL RESULTS

Materials

Cement: Cement is a binder a material that sets and hardens and can bind other materials together. In this project the main object of cement is for binding different other materials used in making mortar. The cement is sieved through 90 micron IS Sieve to avoid lumps in cement. Particles size of the Portland cement affect rate of hydration which is responsible for the rate of strength gain
Sand: It is sieved through 1.75mm IS sieve. Particles of Fine sand acts as a good bonding material between cement and coarse aggregates.

Aggregates: Aggregates are granular materials which are obtained from crushed stone mix with fine aggregate along with water and Portland cement which forms an essential ingredient in concrete. Aggregate acts as a good compressive ingredient in concrete. In this project the Aggregate is sieve through 4.75 mm IS sieve and retained on it is taken into consideration. It is also sieve to differentiate fine aggregate and coarse aggregate.

Optical fiber: An optical fiber is a flexible, transparent fiber made of glass (silica) or plastic, slightly thicker than a human hair. It functions as a waveguide or light pipe, to transmit light between the two ends of the fiber. In this project optical fiber is use as a main material to pass light. The length used is 3cm and total 121 optical fiber are used per cube. The percentage by volume is 2.64.

Mortar: The proportion used for experimental analysis is 1:4.

Concrete: In this project M30 grade concrete is used and water cement ratio is 0.30.

Steel plates: In this project 1.5 mm thick steel plates are used, 6 number of steel plates per mould in which 121 holes of 1mm diameter are drilled with the help of high speed drilling machine. The dimensions of steel plate are

640mm x 620mm. In a mould 6 steel plates were installed at regular intervals to make sufficient space for specimen.

I. RESULTS AND ANALYSIS

A. Light transmitting properties

1) Observation for mortar cubes

Source		Distances				
		0.0 m	0.05 m	0.1 m	0.15 m	0.2 m
Bulb	With Cube	172	128	98	90	45
	Without cube	6900	4800	3650	2500	1650
	Percentage	2.49	2.66	2.68	3.6	2.72
Tub light	With Cube	115	54	65	35	26
	Without cube	3650	2940	1550	940	600
	Percentage	3.15	1.83	4.19	3.72	4.33
Natural light	With Cube	589	580	591	583	520
	Without cube	19400	19300	19300	19400	19400
	Percentage	3.03	3.00	3.06	3.00	2.68

X1= reading of digital lux meter with cubes placed

X2= reading of digital lux meter without cubes placed

Percentage of light passing= $(X1/X2)*100$

2) Observations for concrete cubes

Source		Distances				
		0.0 m	0.05 m	0.1 m	0.15 m	0.2 m
Bulb	With Cube	180	120	98	78	50
	Without cube	6900	4800	3650	2500	1650
	Percentage	2.60	2.5	2.68	3.12	3.03
Tub light	With Cube	110	86	56	30	22
	Without cube	3650	2940	1550	940	600
	Percentage	3.01	2.92	3.61	3.19	3.66
Natural light	With Cube	580	585	582	585	590
	Without cube	19400	19300	19300	19400	19400
	Percentage	2.98	3.03	3.01	3.01	3.04

B) COMPRESSIVE STRENGTH TEST

1) Observation for mortar cubes

	Compressive load KN/m ²			
	3 Days	7 Days	14 Days	28 Days
Cube -1	20	25	30	35
Cube - 2	25	30	35	40
Cube - 3	20	25	35	40
Average	21.66	26.66	33.33	38.33
Strength	0.120	0.148	0.185	0.213

The transmission of light through light transmitting block is depending on percentage of optical fiber used of that surface area. The transmission of light increases with increase of percentage optical fiber. The maximum intensity of light passing through the block for 3% of fiber is 585 lux at box face.

Even if initial cost of light transmitting concrete is more than conventional concrete by 6 times, but due to continuous increase in tariff and it will reduce the carbon emission which is dangerous for the environment.

V. CONCLUSION

As per result analysis it is concluded that for same design of M30mix, the compressive strength of light transmitting concrete is slightly reduced than that of conventional concrete.

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