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EXPERIMENTAL INVESTIGATION ON TRANSMISSION OF LIGHT IN GREEN BUILDINGS USING TRANSLUCENT CONCRETE

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Abstract: *Light transmission (Green buildings) and aesthetical appearance are the two main features which provide the optical fibers to concrete and make the formation of translucent concrete. In this paper the main work done is we used the plastic optical fibers of different diameters ranging from 0.5 mm to 3.0 mm and tests were mainly done on the casting methods and light transmission by varying the percentage of plastic optical fibers in concrete. In initial stage the cost of the translucent concrete is high as there is the use of plastic optical fibers but in long run a lot of energy (artificial energy) will be saved as these fibers will directly allow natural sun light inside the building.*

Key words: **Green buildings, translucent concrete, Aesthetical appearance, structural elements, Hollow plastic pipes, Self-compacting concrete, lux meter.**

1. Introduction:

Green Building (also known as sustainable building) states to both a structure and the using of progressions that are environmentally liable and resource-efficient through the life cycle of a building. In other words, green building plan involves finding the stability between home building and the sustainable environment. With the improvement of science-technology, more and more large-scale civil engineering structures such as skyscrapers, underground buildings and landmark buildings, bridges, elevated roads and so on are built around the world. While the economic growth is a kind of extensive growth: high input, high consumption and high pollution, for that the energy saving technology is low, especially in developing countries. As we all know the brightness of indoor environment is totally maintained by artificial lighting, which has used up a large number of resources. Moreover civil engineering structures constantly suffer from outdoor environmental possessions, economic loss and sufferers are serious once damaged. And now, building energy saving and building safety have been fascinated much consideration. For the meantime some new building ingredients are developed and used in buildings, including self-diagnosis smart concrete, self-tuning smart concrete, self-repairing smart concrete, soundproof concrete, thermal padding concrete and so on. All these purposeful materials only focus on the acumen features, and cannot retain energy saving. But a diverse functional material called translucent concrete not only instructs new features to concrete but also save energy & reduced cost. The transparent concrete block is effectively twisted by mixing adequate volume of plastic optical fibers into concrete. The thought of light transmitting concrete in the form of a broadly applicable new building material was of great appreciation. This concrete has the same strength as regular concrete and will endure to transmit light through walls up to twenty meters (sixty five feet) impenetrable. A wall made of "transparent concrete "have the strength of obsolete concrete and an implanted arrangement of plastic optical fibers that can exhibition a view of the outside world, such as the shape of a tree, for example. The optimism is that the new material will transmute the interior appearance of concrete buildings by production them feel light and airy relatively than dark and heavy. It can be used for inside or exterior walls, irradiated pavements or even in art or design objects. By infusing the concrete with plastic optical fibers, light can be transmitted from the outdoor in or inside out.

2.Literature review:

Zhi Zhou1,2, Ge Ou, Ying Hang, Genda Chen, Jinping Ou.,

A novel construction material named smart transparent concrete was developed using POF and FBG. The light transmitting, mechanical properties and self-sensing performance were cautiously investigated and the stated hypothesis of its light guiding capability was confirmed. FBG arranged in concrete can sense the inner deformation of concrete specimens under pressure and the changing tendency of the internal fiber grating is consistent with that shown in the electric resistance strain gauge tests. Such research and experimentation provides solid evidence for the intelligence of this system in structural safety assessment. With regard to the energy-saving

aspect, POF-based concrete allows the use of sunlight for illumination; in the case of emergencies, transparent concrete will provide some relief in the case of daytime power outage for skyscrapers, making evacuation safer and more efficient. Additionally, a smart transparent concrete is aesthetically pleasing. 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, Zhi Zhou and Jinping Ou

A novel construction material named smart transparent concrete was developed using POF and glass fiber with large diameter, in which the POF is used as light transmission element and glass fiber is a sensing element to monitor the stress state of structures, and could be regarded as an art material to be used in museums and specific exhibitions. Based on the test of transmission, self-sensing and durability of the smart concrete, the following results have been gotten:

1) The smart transparent concrete has good light guiding property, and the POF volume ratio to concrete is proportion to transmission.
2) The stress birefringence property of glass fiber make itself a good sensing element to measure the inner stress of smart transparent concrete. Comparison to the three experimental conditions, it can be seen that the stress state of glass fiber can reflect the stress state of concrete, which make the self-sensing property.
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.

Varsharaina,

A novel architectural material called transparent concrete can be developed by adding optical fibre or large diameter glass fibre in the concrete mixture. The transparent concrete has good light guiding property and the ratio of optical fibre volume to concrete is proportion to transmission. The transparent concrete not looses the strength parameter when compared to regular concrete and also it has very vital property for the aesthetical point of view. It can be used for the best architectural appearance of the building. Also used where the light cannot reach with appropriate intensity. This new kind of building materialcan integrate the concept of green energy saving with the usage self-sensing properties of functional materials.

Basma F. Bashbash.

Compressive strength for 7 days

It's noticed that Compressive Strength increase when fiber content increase until reach 4%, then Compressive Strength decrease at 6% fiber content for all diameter. But the concrete have maximum compressive strength after 7 days at 4% fiber content, because the larger fiber content decrease the bonds between concrete. But 7 days results still not the indication for research work and 28 days result have to be taken in consideration.

Compressive strength for 28 days

From the results of 28 days, it's noticed that Compressive Strength decrease until fiber content increase, that return to decrease weight for concrete with fiber. On the other hand, the results shown that the larger diameter have high Compressive Strength for the same fiber content. The 28 days results is the best indication for research work so conclude that the best diameter is 3mm and the more fiber content the weaker compressive strength.

Flexural strength for 28 days

Flexure strength is slightly decreased with fiber content 2% to 20%- 55% with several diameters also at fiber content from 2% to 6% is observably decrease .

A.B. Sawant

Regarding Cost:

Even if initial cost of the light transmitting concrete is more than conventional concrete by 12 time, but due to continuous increase in tariff and pay back calculation done, from the payback analysis it can be concluded that a wall of 16 block (0.360 sqm area) constructed then the saving of electricity bill is 838.03/-Rs. So the payback period for excess amount invested for light transmitting block will be recovered in 3.5 years for domestic consumption and 2.1 years for commercial and industrial consumption. It will also reduce the carbon emission which is dangerous for the environment. Hence this can be treated as one of the high performance concrete. The use of this high performance light transmitting concrete is beneficial for protecting mother earth.

3.Methodology

To safeguard alignment of optical fibers we will use superplasticisers in concrete to make it self-compacting so no tamping and vibrations are required. Hence concrete will get compacted by its self-weight only.

Secondly we will use hollow plastic pipes which will protect fibers to get deflected and these pipes will be pulled out once the placing of concrete is over that time the concrete will be in its initial [plastic] stage.

3.1 Materials used

i)Plastic optical fibers

Concrete is a diverse hefty building material which is mostly serene of cement aggregates and water. By the accumulation of different admixtures like superplasticisers, self-curing agents, self-healing agents, its possessions can be changed

But consuming this concrete as a building material is a big hindrance to allow light directly to pass through. Therefore By presenting optical fibers in concrete which will act as intermediate for light to travel through concrete we can directly permit the day light to pass through it, henceforth acts as an energy efficient foundation in green buildings and the passageway of light means passage of vision hence referred as translucent or transparent concrete.

Plastic optical fibers are

- Stretchy, transparent fiber made up of plastic.
- It diffuses light amid two ends of the fiber.
- Optical fiber communicates light so successfully that there is almost no loss of light steered through the fibers.

ii) Self compacting concrete

Self-compacting concrete (scc) was used for the experiments to avoid tamping and vibrations by which the orientation of plastic optical fibers could have been disturbed. For preparation of scc different trial mixes was prepared separately and tested to get the sufficient results. SCC has the ability to fill the form work and encapsulate plastic optical fibers only through the action of gravity i.e. self-weight at the time of placement without any external energy inputs from vibrators, tamping or similar actions and with maintained homogeneity at the time of placement.

Objective

The experiments were conducted to find out the

1) Suitable scc mix
2) To find out the perfect casting procedure of translucent concrete.
3) To check the variation of light by changing the diameter and percentage of optical fibers

4.Results and Conclusions:

For prepration of SCC:

From different trials of scc it was finally decided to use scc of mix (M25) which was prepared using

Cement: fine aggregates: coarse aggregates ratio of (1:1.08:1.64) I,e (510 : 551 : 852)kgs/mt. cube for which w/c ratio was taken as 0.4% , also the admixture used was PCA which was used at 1.7% by weight of cement.

Different cubes were casted foe the same mix and we get their compressive strength as below

cubes	Peak load (KN)	Compressive strength N/mm sq.
01	547.30	24.32
02	544.50	24.20
03	595.8	26.48

The results shown in the above table are taken after 28 days of curing and the mean of the above three values was taken as 25.

Light transmission tests:

Tests on transmission of light through concrete was determined by using an instrument used to measure the intensity of light known as LUX METER.

Different samples of surface area 225 sq. cm were casted to measure the intensity of light in which different diameters of fibers like 0.5mm, 2.0 mm, and 3.0mm were used and varying the percentage of these fibers by volume of total concrete from 0.17 % to 9.04%.

FOR 0.5MM DIA POF

No. of fiber strands used.	%ge of fibers by volume of total concrete	Intensity of light (lux) using sun as light source
49(7x7)	0.17	0.89
56(7x8)	0.20	0.92
64(8x8)	0.22	0.96
72(8x9)	0.25	1.10

FOR 2.0MM DIA POF

No. of fiber strands used.	%ge of fibers by volume of total concrete	Intensity of light (lux) using sun as light source
49(7x7)	2.74	1.67
56(7x8)	3.13	1.85
64(8x8)	3.57	1.97
72(8x9)	4.02	2.40

FOR 3.0MM DIA POF

No. of fiber strands used.	%ge of fibers by volume of total concrete	Intensity of light (lux) using sun as light source
49(7x7)	6.15	2.97
56(7x8)	7.03	3.34
64(8x8)	8.04	3.83
72(8x9)	9.04	4.12

Hence from the above results it is clear that sufficient amount of light can be transmitted through these plastic optical fibers from outside into the rooms or buildings, by which we can save huge amount of artificial energy and also by allowing the sunlight directly inside we get the most number of benefits like vitamin D, sunlight as a disinfectant, sunlight as UVB, sunlight as treatment for S.A.D and many other benefits of sunlight.

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6.References:

[1]. Zhi Zhou1,2, Ge Ou, Ying Hang, Genda Chen, Jinping Ou., Research and Development of Plastic Optical Fiber Based Smart Transparent Concrete, published on Proc. of SPIE Vol. 7293 72930F-1

[2]. Jianping He, Zhi Zhou and Jinping Ou, Study on Smart Transparent Concrete Product and Its Performances ,proceedings of The 6th International Workshop on Advanced Smart Materials and Smart Structures Technology ANCRiSST2011 July 25-26, 2011, Dalian, China

[3]. Varsharaina, "A Study on Transparent Concrete: A Novel Architectural Material to Explore Construction Sector", International Journal of Engineering and Innovative Technology, volume 2, issue 8, pp83-87, (2013)

[4]. Basma F. Bashbash. (2013). "Basics of light Transmitting Concrete", pp 079-083, (2013)

[5]. A.B. Sawant (2014) "Light Transmitting Concrete by using Optical Fiber" International Journal of Inventive Engineering and Sciences (IJIES) ISSN: 2319–9598, Volume-3 Issue-1, December 2014.