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An Experimental Study On Lightemitting Concrete

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Abstract
This project deals with light emitting property of concrete by using optical fibres. This project study which not only includes Aesthetical consideration but also the strengthening property of optical fibres in concrete by increasing the percentage of concrete from 2.5% to 5.5%. The deflection in concrete has been determined using ANSYS software where accurate result has been determined and ANSYS analysis shows that decrease of deflection in optical fibre concrete compared to that of conventional concrete. The application of this concrete is energy saving. This project result show that optical fibres can be easily combined with concrete and thus optical fibres will provide a steady light emitting ratio. This project also shows the mechanical effects by introducing optical fibres into concrete. This concrete can be considered as a green energy saving concrete. The compressive strength of light emitting concrete is seen increase with increase in percentage of fibre optic content upto 4.5% and flexural strength of this concrete is also tends to increase in strength up to 4.5%. The deflection behaviour concrete has been determined analytically using ANSYS software version 2014. As the construction, maintenance and operation of the built environment undergoes significant changes based on demands in lower energy consumption, low CO2 emissions higher durability and long lasting quality, the building industry is delivering with innovative solutions in new construction methods and technologies. This concrete makes use of more opportunities for new emerging products and construction methods. This research experiment will be a series of initiatives to look closely at new and emerging advanced construction in future.

Keywords
Optical fibre, ANSYS, strength, deflection, green energy saving

I. Introduction

Light Emitting Concrete is a combination of fibre optics and concrete. 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. Because of their parallel position of fibre, the light-information on the brighter side of a wall appears unchanged on the darker side. The sharp display of shadows will fall on the opposing side of the wall. Today we are living in a world where energy expenditure and environmental problems have escalated to global scale. In today's developed world our built environment takes energy energy to make the materials that go into the buildings, energy to construct them (Embodied energy) and energy to heat, cool & light them (Operating energy). Our project of casting translucent concrete aims at reducing this operating energy by exploiting vast amount of potential energy in the form of sunlight. Another additional feature is its pleasing aesthetics that can change the image of the concrete which is generally perceived as dull, pale, opaque grey material.

II. Need for Study

Thus by using light emitting concrete produces a prefabricated building block and panels. With the economic growth and science and technology development, many large scale civil engineering structures such as tall buildings and so on are built around the world. Most of the large buildings are built close to each other, there is not much natural sunlight passing through and the importance of natural sunlight is well known. In total usage of electricity 30%vf electricity is used for lightening purpose only, so it is necessary to utilize natural light for illuminating interior of building. It is totally environment friendly because of its light transmissive characteristics. Moreover the light emitting concrete does not loses the strength parameter when compared to conventional concrete.

III. Materials

1. Cement: The cement used in this experimental works is Portland cement 53 Grade Ordinary Portland Cement. All properties of Cement are tested by referring IS12269-1987 Specification for 53 Grade Ordinary Portland cement. The specific gravity of Cement was 3.14. The initial and final setting times were found as 50minutes and 545minutes respectively. Standard consistency of cement was 39.99%.

2. Fine aggregate: Locally available sand passed through 4.75mm IS sieve was used The specific gravity 2.62 and fineness modulus of 2.79 were used as fine aggregate. The loose and compacted bulk Density values of sand are 1601 and 1686 kg/m3 respectively, the water absorption of 0.10%.

3. Coarse aggregate: Crush granite aggregate available from local sources has been used The coarse aggregate with maximum size of 10mm having the specific gravity value of 2.67 and fineness modulus of 6.21 were used as a coarse aggregate. The loose and compacted bulk density values of coarse aggregate are 1501kg/m3 respectively, the water absorption is 0.15%.

IV. Optical Fiber Elements

1. Core - The thin glass centre of the fiber where the light travels is called core.
2. Cladding-The outer optical material surrounding the core that reflects the light back into the core. To confine the reflection in the core, the refractive index of the core must be greater than that of the cladding.
3. Buffer Coating– This is the Plastic coating that protects the fiber from damage and moisture shows the different part of optical fiber and ray path.

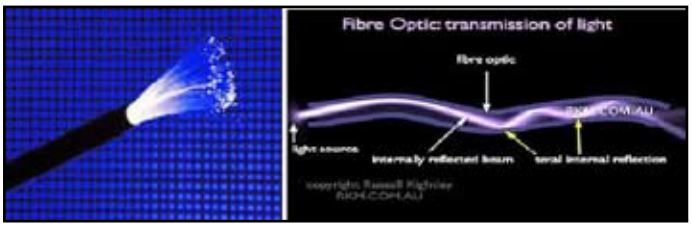

Fig 1: Optical fibre

V. Types of Optical Fiber

There are three basic types of optical fibers:

1. Multimode graded-index fiber.
2. Multimode step-index fiber.
3. Single-mode step-index fiber.

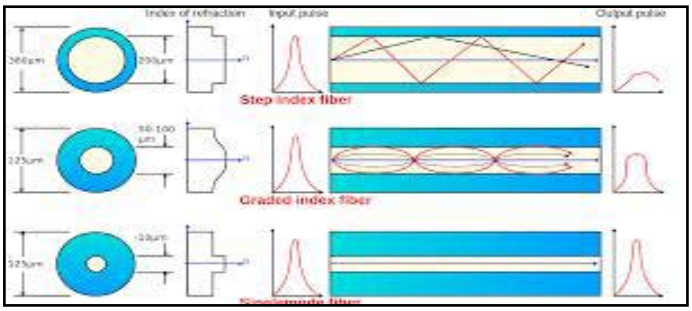

Fig 2: Types optical fibre

VI. Mix Proportion Ratio Of Concrete:

Table1: Mix ratio of M_{30} grade of concrete

cement	Fine aggregate	Coarse aggregate	w/c
1	1.87	3.37	0.45

Table 2: Mix proportion of optical fibre concrete

% of OFC	0% OFC	2.5% OFC	3.5% OFC	4.5% OFC	5.5% **OFC**
Cement (kg/m^3)	380	380	380	380	380
LEC	-	17.75	24.85	31.95	39.05
FA (kg/m^3)	710	692.25	685.1	678.05	670.95
CA **(kg/m^2)**	1280	1280	1280	1280	1280
w/c	0.45	0.45	0.45	0.45	0.45

VII. Preparation Of Mould

In the process of making light transmitting concrete, the first step involved is preparation of mould. The mould required for the prototype can be made with different materials which can be of either tin or wood. In the mould preparation, it is important to fix the basic dimensions of mould. The standard minimum size of the cube according to IS 456-2000 is15cmx15cmx15cm for concrete. In the mould, markings are made exactly according to the size of the cube so that the perforated plates can be used. Holes are drilled to the metal sheet which is 2mm diameter hole

Fig 3: Wooden mould

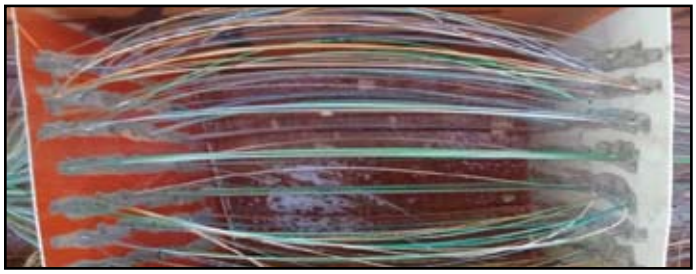

Fig 4: fixing of fibre

1-Preparation of the Mould: Make the required size of rectangular mould from wood Place the clay mud into the mould up to half of height of mould and fixing of fibre in mould vertically up to the height of mould

Fig. 5: Preparation rectangular mould

2- Concreting: Pouring the concrete mixture in smaller or thinner layer carefully in mould

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Fig 6: Pouring of concrete in mould

3- Removing the Mould: After 24 hrs. Remove the mould and pull off the mud.

4- Cutting and polishing: Cut the extra-long fibers same as thickness of panel. Polished the panel surface by using polish paper.

Fig 7: Light emission in light emitting concrete

VIII. Compressive Cubes Test

In this study, several wooden moulds that are made in a certain form. These wooden moulds contain three cubes of 15*15*15 cm, each cube separated by perforated plates, these perforated plates were provided with the maximum number of holes to allow all fibers for the maximum fiber content applied to pass through in this study Average compression test Results of Normal concrete with Optical fiber concrete of 2.5% to 5.5% respectively.

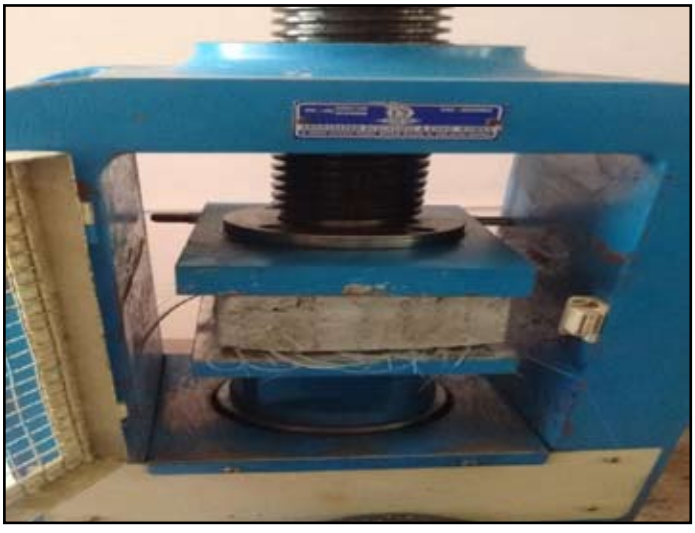

Fig 8: Compressive test of light emitting concrete

Table 3: Compression test result of conventional concrete and optical fibre concrete with different percentage.

No of Day	0% Optical fibre	2.5% Optical fibre	3.5% Optical fibre	4.5% Optical fibre	5.5% Optical fibre
7 Days	25.49	26.15	27.25	29.68	28.47
14 Days	28.58	29.49	30.41	33.75	32.52
28 Days	40.27	40.56	41.23	43.85	40.01

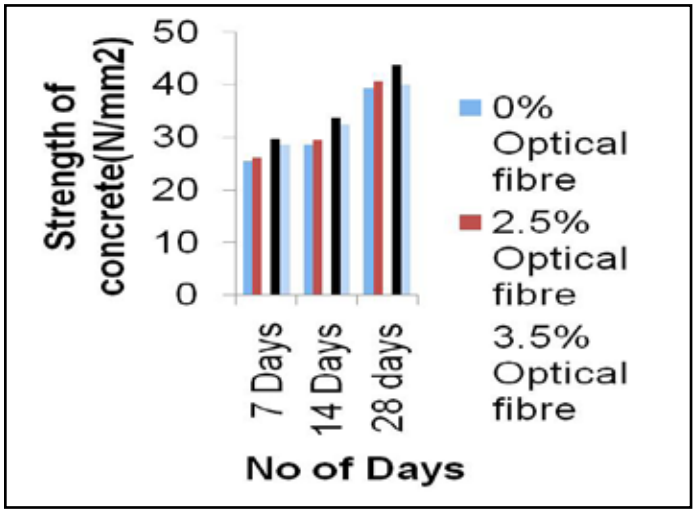

Fig 9: Graph of compression test concrete

IX. Flexural Cubes Test

Table 4: Flexural test result of conventional concrete and optical fibre concrete with different percentage.

No of Days	0% Optical fibre	2.5% Optical fibre	3.5% Optical fibre	4.5% Optical fibre	.5% Optical fibre
7 Days	2.31	2.53	2.66	3.10	2.49
14 Days	3.58	3.68	3.80	4.25	3.41
28 Days	4.12	4.49	4.75	5.01	4.76

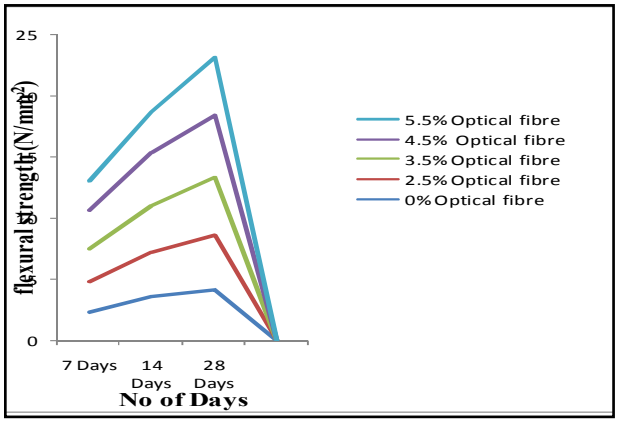

Fig 10: Graph of flexural test of concrete

X. Ansys Analysis of Conventional and Fibre Optic Concrte to Determne Deflection Analcticaly

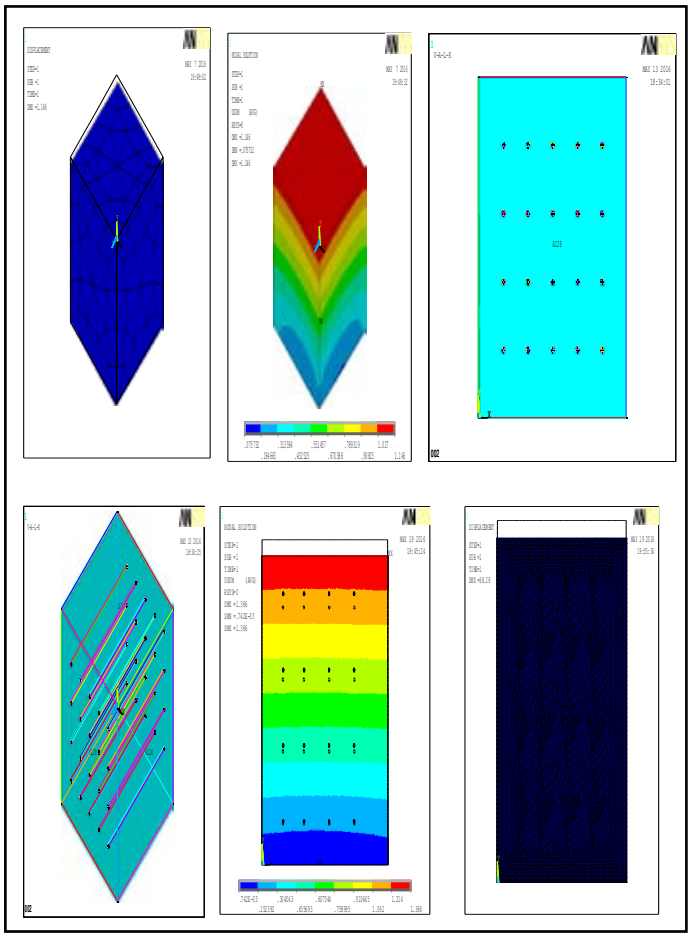

Fig 11: ANSYS analysis of conventional and optical fibre concrete and deflection

Table 5: Report of deflection in concrete in ANSYS

S. No	Compression load (N)	Conventional concrete (deflection in mm)	Light emitting concrete deflection in mm)
1	100	1.37	1.15
2	1000	13.66	14.49
3	2000	27.31	28.98
4	3000	40.97	39.14
5	4000	54.62	57.95
6	5000	68.28	70.92

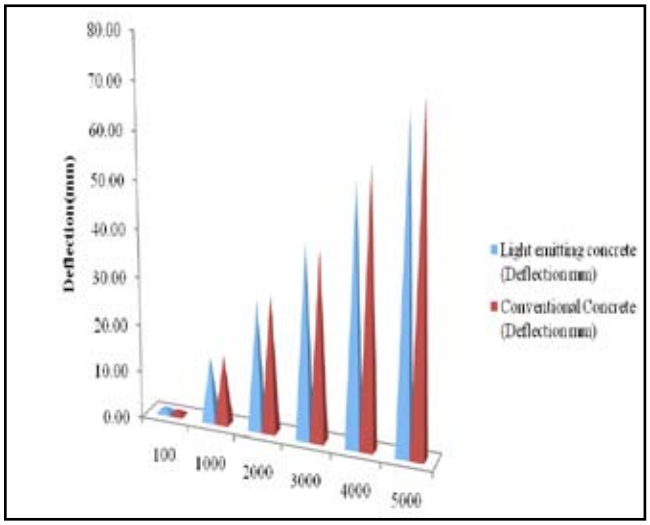

Fig 12: Graph of ANSYS analysis of conventional and optical fibre concrete and deflection

XI. Conclusion

From tabulated results and graph drawn according to the tables, it can be conclude that the compressive strength of concrete block increase with increase in the percentage of fibers used in concrete. As per observation and comments discuss in previous points further project work was carried out on 2.5%, 3.5%, 4.5% and 5% of fibers. The strength concrete is high at 4.5% and gradually decreases at 5.5% respectively. From the above evaluation of result of ANSYS analysis of conventional concrete and optical fibre concrete the deflection of optical fibre concrete is comparatively less to that of conventional concrete in terms of increase in load of concrete.

The efficiency of the application of optical fibre is studied by comparing the strength with the normal M_{30} grade concrete and the test results proved that the efficiency is more in all aspect. Hence the application of optical fibre will make the concrete decorative as well as can make the concrete structural efficient. The smart transparent concrete has good light guiding property. Weighs about the same as that of conventional concrete.

By using light emitting concrete we can acquires the following advantages

- Creating an Ecologically Solution because optical fibre is made of glass and it is organic
- By using light emitting concrete it acquires minimum power consumption
- Light emitting concrete can be used in prefabricated structures
- In future if this project largely carried out, lot of industry may developed and so obviously concrete may get reduce in cost and it become economical
- It requires less motor for construction, since concrete used for wall panel we can make different shape according to the wall size, so we save time, it will increase the speed of construction.
- The strength concrete is highly efficient

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