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A REVIEW ON DIAPHANOUS CONCRETE

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Abstract - *The concrete currently used in the construction industry generally consists of cement, water and aggregates. Concrete has a greyish colour. Its high density does not allow light to pass through it. That means it is impossible to distinguish bodies, colours and shapes through it. Diaphanous concrete is a concrete based material which has light-transmissive properties, due to Optical fibres in it. Light is passed through the fibres from one end to the another end. It creates some light patterns on other surface. My paper deals with the review of diaphanous or transparent concrete blocks and their uses and also with the advantages it brings in the field of smart construction.*

Key Words: Transparent concrete, Optical fibre, Smart construction, Architectural Appearance, Light transmitting property.

1. INTRODUCTION

In today's world Energy conservation has become an important issue. The carbon released by commercial, institutional and residential buildings will amount to 3800 tonnes and this carbon will consume 38% of the global energy by 2050. To reduce the consumption of energy by buildings and the upcoming construction in future, development of a new construction material which will consume less amount of energy has attracted the attention of many researchers. Diaphanous concrete is one such material. Concrete is one of the most basic materials required during all types of construction. Diaphanous concrete is an innovative concrete which has the ability of letting light pass through it.

Concrete has a key role in development of infrastructure and housing. Due to great economic growth, population growth and space utilization worldwide, there is drastic change in construction technology. Small buildings are replaced by high rise buildings and sky scrapers. Thus arises one of the problem in deriving natural light in building, due to obstruction of nearby structures. Due to this problem use of artificial sources for illumination of building is increased by great amount. So to reduce the artificial light consumption in structure has become very essential

The concrete generally used in construction generally consist of at least cement water and aggregates (fine or course). Conventional concrete has high density which does not allow light to pass through it, which means that it is also impossible to distinguish bodies, shapes and colours through it. Concrete with the characteristic of being diaphanous will permit a better interaction between the construction and its environment. Thereby creating ambiences that are better and more naturally light, at the same time as significantly reducing the expenses of lying and maintenance of the concrete.

With the aim of eliminating these and other drawbacks, thought has been given to the development of a diaphanous concrete, which concerns a formulation of concrete which permits light to pass through it and works more efficiently in the mechanical sense than traditional concrete.(Fig. 2)

2. MATERIAL USED FOR DIAPHANOUS CONCRETE

There are two common materials used for making diaphanous concrete, one is from construction field i.e. cement or concrete and another from sensing field i.e. optical fiber.

2.1 Optical Fibers

An Optical Fibres a flexible, diaphanous fibre made of glass (silica) or plastic, slightly thicker than a human hair. The field of applied science and engineering concerned with the design and application of optical fibres is known as fibre optics. Optical fibres typically include a diaphanous core surrounded by a diaphanous cladding material with a lower index of refraction. Light is kept in Experimental Study of Effect of Optical Fibre on Compressive Strength of Concrete the core by total internal reflection.. This effect is used in optical fibres to confine light in the core. Light travels through the fibre core, bouncing back and forth off the boundary between the core and cladding. Because the light must strike the boundary with an angle greater than the critical angle, only light that enters the fibre within a certain range of angles can travel down the fibre without leaking out. This range of angles is called the acceptance cone of the fibre. The size of this acceptance cone is a function of the refractive index difference between the fibber's core and cladding.

2.2 Cement Concrete

Cement: Selection of the type of cement will depend on strength and durability of the concrete required

Fine Aggregate: Aggregates are natural or artificial substance may or may not be crushed like stone, gravel, sand, furnace clinker etc. There are various properties of aggregate which have to check before use in concrete such as Basic properties- Specific gravity, water absorption, and mechanical properties like fineness modulus, slit content etc. must be determine before use in concrete, these all properties directly effect on design and behaviour of concrete. Here we select crushed aggregate of passing through 4.75 mm sieve and retained on 1.28 mm sieve due to spacing fibres in the mould and tested for its properties. All normal concreting aggregates are suitable for Litracon. Both crushed and rounded aggregates can be used. To avoid segregation a minimum amount of fine arising from binders and sand must be achieved.

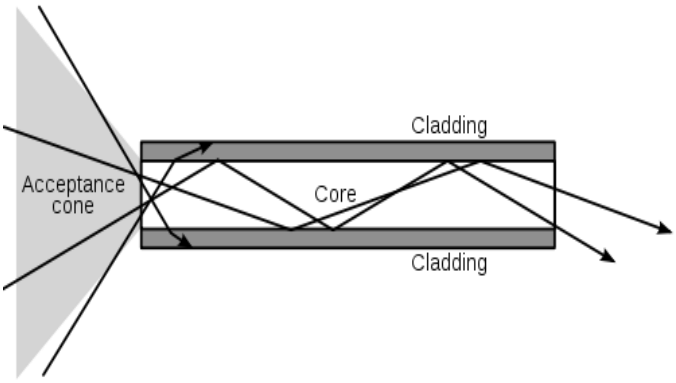

Fig. 1. Internal reflection of optical Fiber

3. PRINCIPLE

Diaphanous concrete or Transparent concrete is work Based on "Nano-Optics". Optical fibres passes as much light when tiny slits are placed directly on top of each other as when they are staggered. The surface of wall can be built with these blocks and the blocks can be produced in various sizes and with embedded heat-isolation. Due to the small size of the Fibre s, they blend into concrete becoming a component of the material like small pieces of aggregate. The glass Fibres leads light by points between the two sides of the blocks. Moreover, the colour of the light also remains the same. This new product, then, is a combination of optical fibres and fine concrete and can be produced as building blocks or panels. The fibres blend into the concrete and become part of the material like small pieces of aggregate.

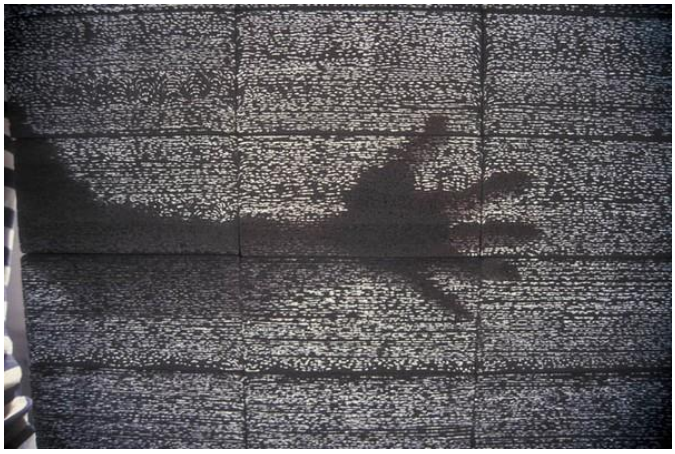

Fig. 2. Internal Transparent concrete blocks

4. APPLICATION

4.1 Embellish your walls

Diaphanous concrete can be used as building material for interior and exterior walls. If sunshine illuminates the wall structure then eastern or western placement is recommended; the rays of the rising or setting sun will hit the optical glass fibers in a lower angle and the intensity of the light will be bigger. Besides the traditional applications of a wall, the light transmitting concrete can also be used as wall covering illuminated from the back (Fig. 3)

Fig. 3. Transparent concrete wall

4.2 Diaphanous Concrete Stairs

Diaphanous Concrete product can be used in horizontal and vertical applications with impact Lighting Linear LED fixtures. (Fig. 4)

Fig. 4. Transparent concrete staircase

4.3 Get Creative with Design

We can also create a logo with colorful figures, inscriptions and pictures. (Fig. 5)

Fig. 5. Transparent design concrete blocks

4.4 A Lighting fixture and Conversational Piece

The diaphanous concrete cube is a great conversation piece. The cube line consists of four identical pieces of concrete. The pieces form a stable structure without fixing them together due to its special geometry. (fig. 6)

Fig. 6. Transparent concrete cube

5. CONSEQUENCES OF DIAPHANOUS CONCRETE

5.1 Advantages

- Diaphanous concrete inserts on front doors of homes, allowing the resident to see when there is a person standing outside.
- Diaphanous concrete walls on restaurants, clubs, and other establishments to reveal how many patrons are inside.
- In any large office building or commercial structure incorporating, ceilings of diaphanous concrete would reduce lighting costs during daylight hours.
- Lane markers in roadways could incorporate various colours in the diaphanous concrete, allowing for dynamic adjustments when required by traffic fluctuations. Sidewalks poured with diaphanous concrete could be made with lighting underneath, creating lit walkways which would enhance safety, and also encourage foot travel where previously avoided at night.
- The use of diaphanous concrete in an outer wall of an indoor stairwell would provide illumination in a power outage, resulting in enhanced safety.
- Subways could be illuminated in daylight by using this material

5.2 Disadvantages

1. The main disadvantage is these concrete is very costly because of the optical fibres.
2. Casting of transparent concrete block is difficult for the labour so special skilled person is required.
3. It is precision material and the correct procedure need to be followed.
4. It is extremely important to ensure the integrity of optic strands if they break within the product property would almost be Neglected.

6. CONCLUSION

Diaphanous concrete can be used in many ways and implemented into many forms and be highly advantageous. When optical fibres were replaced in concrete mix from 2 to 8% with rising interval of 2% it was observed that strength goes on increasing as % of replacement increases. Flexural strength was observed for replacement of optical fibre and it can be concluded

that flexural strength increases as % of replacement increases when compared to control mix. Yet, the only drawback would be its high cost; the cost increases as the % of optical fibre increases, but that doesn't stop high class architects from using it. It can be used for the best architectural appearance of the building.

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