



TRANSLUCENT CONCRETE: UNFOLDING TOWARDS BRIGHTER WORLD

Tanpreet Singh* | Dr. Jyoti Bhatnagar** | Dr. Amanjot Singh***

*Research Scholar, Himalayan University, Itanagar, Arunachal Pradesh, India.

**Supervisor, Professor, Himalayan University, Itanagar, Arunachal Pradesh, India.

***Co-Supervisor, Associate Professor & Dean Academics, Himalayan University, Itanagar, Arunachal Pradesh, India.

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ABSTRACT

This paper deals in concrete which has property of transmittivity of light through hard concrete due to embedded optical fibres through one end to other. In market there are many types of concrete, depending upon what researchers want to achieve by altering the chemical and physical properties by adding additives etc. All these concretes are used to make durable structures. Secondly, some other aesthetics like architecture are constructed with the help of concrete. The light is transferred through the optical fibres from one end to another end. Translucent concrete is also known as light transmitting concrete, the main objective of this concrete is to transmit white light i.e. sunlight through concrete surface so as to minimize the energy consumption and the results evidently showed that this concrete can be used as energy efficient device and acts as green constructional material but the initial cost of this concrete is quite high.

Keywords: Optical Fibre, Translucent concrete, Durability, Energy efficient, Light emitting device.

ABOUT AUTHORS:



Author, Tanpreet Singh is Research Scholar, Himalayan University, Itanagar, Arunachal Pradesh, India.



Author, Dr. Jyoti Bhatnagar is Supervisor, Professor, Himalayan University, Itanagar, Arunachal Pradesh, India.



Author, Dr. Amanjot Singh is Co-Supervisor, Associate Professor & Dean Academics, Himalayan University, Itanagar, Arunachal Pradesh, India.

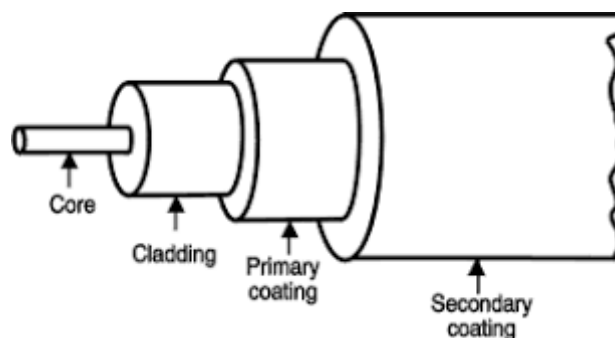
INTRODUCTION

Civil Engineering has come a very long way in the field of construction since Roman times. Some say it's a science of civilization. Today the time has come where energy expenditure and environmental issues have rise to global level. With the rise of population there is a need for smart construction and other wise economical substitutes in this sector. Due to rapid urbanization the, most of the tall buildings are build very close to each other like sky scrapers. By the type of closed stacked construction there is not much passing of white light. In fact, more than 50 percent day light is mandatory as per (IGBC) Indian Green Building Council accounting 3 credits.

By research and development, emerging developed concrete has been created which is more resistant, lighter in weight and light transmitting. The first transparent concrete was developed by putting large numbers of optical fibres in freshly mixed concrete in 2003, after named as LitraCon.

MATERIALS REQUIRED

1. **Cement:** It is a versatile material in civil engineering that acts as a binder in concrete that sets hardens and also reacts with CO_2 . In translucent concrete the optical fibre is responsible for the transmitting the light through concrete from end to end, No such special type of cement is required for this type of concrete, usually OPC or PPC cement is readily available in market for the construction of this type of concrete.
2. **Fine Aggregates:** It is non-reactive clean and dry sand mostly passes through 4.75 mm IS sieve. It acts as a filler in concrete. The tests are being conducted as per IS 650-1996 for Specific gravity and IS 2386-1968 for Fineness Modulus test.
3. **Coarse Aggregates:** Crush granite aggregate readily available from local sources has been used. The coarse aggregate with maximum size of 10 mm having the specific gravity is 2.6. The fineness modulus of 5.60 was used as a coarse aggregate. The water absorption is 0.4%.
4. **Optical Fibre:** the optical fibre has further divided in to three elements:
 - a. Core
 - b. Cladding
 - c. Buffer Coat



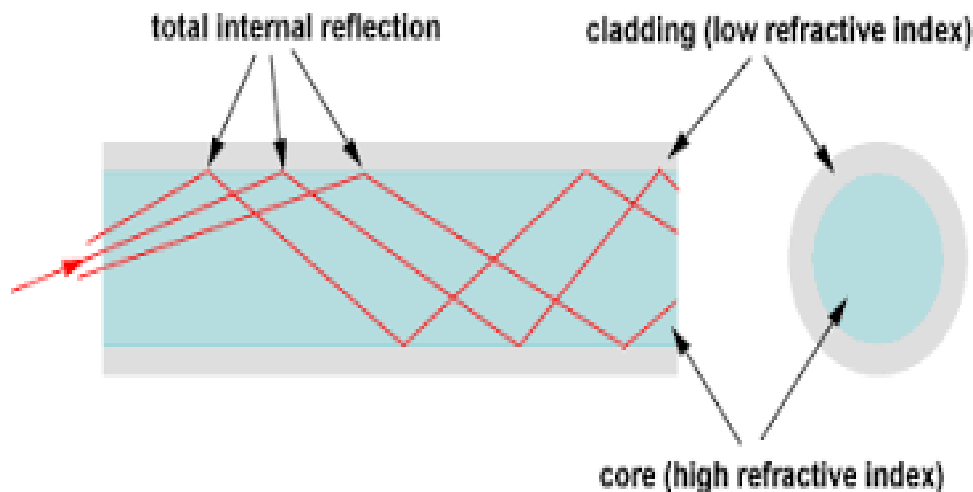
Structure of Optical Fibre

- a) **Core:** the innermost central part of fibre where the light travels is called as Core. The central tube is made of up optically transparent dielectric medium and carries the light from the transmitter to the receiver end.
- b) **Cladding:** the outer material of core which surrounds throughout the length that reflects the light back into the core. The confine the Total Internal Reflection in the core the refractive index of core is much greater than the cladding.
- c) **Buffer Coating:** This is the plastic coating that protects the optical fibre from external damage and moisture.

OPERATING PRINCIPLE OF OPTICAL FIBRE

This working of translucent concrete is based on Nano-Optics. The principle behind the light transmission through optical fibre is total internal reflection (TIR) shown in figure 1. This property means when the light strikes a medium boundary at an angle more than the critical angle w.r.t normal. If the outer boundary (cladding) has lower refractive index (RF) than the inner (core), it reflects back entirely with zero loss of energy showing in figure 1. In translucent concrete, core part of optical fibre is used and concrete surface itself acts as cladding. Optical

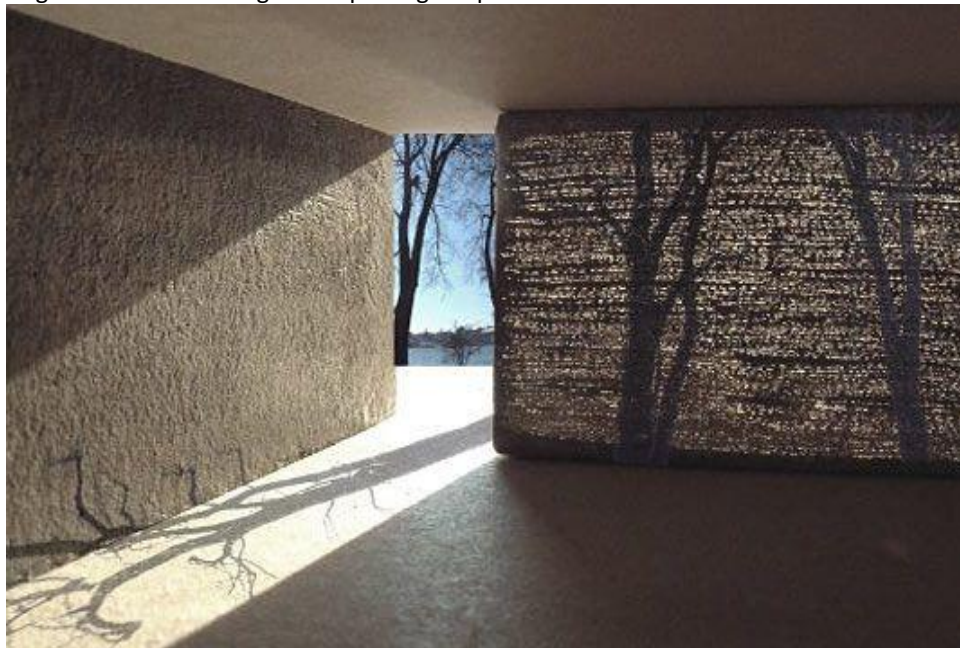
fibres in the concrete is behaving like a slit and carries light across the concrete. These fibres become a structural component of concrete as they get mixed with concrete so well due to their minimal dimension.



Total Internal reflection of Optical fibre

VARIOUS IMPLEMENTATION OF TRANSLUCENT CONCRETE

i. Translucent concrete can be used to lighten up the brick wall as the white light on another side wall falls on wall. This indirect light from the wall brightens up and gives a special effect.



Translucent Wall

ii. This concrete can be used as ceiling or floor for large commercial buildings to reduce the energy consumption at daytime. During the day, the floor will act as normal concrete but at night it begins to glow.



Translucent Ceiling

iii. It can be incorporated in the road pavements or speed breakers in the parking lots or highways illuminated beneath to help the driver to manoeuvre the vehicle.



Translucent Pavement

iv. Translucent concrete can be opt as decorative reception desk, furniture. light fixtures, logos and other aesthetic structure.



Translucent Furniture

v. Translucent concrete can be used in staircases and subways to make it accessible to use during power cut.



Translucent Stairs Case

vi. Translucent concrete can be used as inner partition wall at museums, schools, airports and library by considering the safety and supervision aspect in account.



Translucent Partition walls of Library

ADVANTAGES OF TRANSLUCENT CONCRETE

1. Energy cutting cost can be done in translucent concrete building.
2. The place where light cannot fall directly, at that place this type of construction is useful.
3. It has great architectural aesthetical view to the buildings.
4. It's totally environment friendly all because of its light emitting features, so the energy utilization is minimized.
5. This concrete use white light as source of light instead of electrical energy and reducing power consumption.
6. This type of concrete can be used in all type of weathering conditions countries.

DISADVANTAGES OF TRANSLUCENT CONCRETE

1. The major disadvantage of this concrete is high cost of optical fibres.
2. Casting of concrete is difficult as compared to normal concrete, as skilled labour is required for this type of construction.



CONCLUSIONS

The emerging material called as translucent concrete can be prepared by filling optical fibres of various diameters in concrete mix. With an addition to it, broken glass can be used in concrete mix as an additive so to give reflecting properties of concrete and to make concrete sustainable and can minimize the overall cost of concrete to some extent. The translucent concrete has good light guiding properties and the ratio of optical fibres volume to concrete is proportional to transmitting the light from the concrete. The strength parameters are just similar to normal concrete and it gives the good aesthetic point of view. Translucent concrete can be used in walls, ceiling and panels for the best architectural appearance of the building. It can also be used in a field, where the sunlight cannot reach directly with suitable intensity.

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