E3S Web of Conferences **391**, 01206 (2023) https://doi.org/10.1051/e3sconf/202339101206
ICMED-ICMPC 2023

Litracon: An alternative source for conventional concrete

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Abstract. The consumption of artificial light, especially in urban areas, leads to global warming. As a remedy this light transmitting concrete acts as a solution for global warming. Light transmitting concrete is made with cement ,water , very fine sand and thousands of optical fibres reinforced in concrete from one face to another face which guide the light passing through it. Light transmitting concrete is a concrete that is improved in terms of transparency by installing optical fibres into concrete. We used 3% of optical fibre in this concrete. Due to its pellucidity property, it is also called translucent concrete. The application of light transmitting concrete which allows light to transmit through non-transparent concrete reduces energy in closed environments and global warming. Translucent concrete is used in fine architecture as a decorative material. It has all these properties which an eco-friendly technique should have to keep up the green building concept into consideration. The present investigation about the light translucent concrete by using optical fibre and comparing it with conventional concrete. Compressive strength test is performed on the concrete specimen. Utilising 3% more optical fibres enhanced the compressive strength. compressive strength of concrete cube depends on the diameter of the holes in the mold & the diameter of the optical fibre. It is directly proportional to its compressive strength.

1 Introduction

Concrete has been used to create infrastructure and dwellings since the Roman era, but its core parts have not changed. The dry mix is made up of cement, a fine powder ingredient that binds the components together when water is added, fine aggregate (smaller particles like sand), and coarse aggregate (larger chunks of material like stones or gravel). Because of the expanding urbanisation of the 1960s, concrete was commonly misunderstood, disliked, and captivated by its image stuck. However, concrete has improved greatly in terms of both technical and aesthetic elements since then.It is no longer the heavy, drab, and dreary material of yesteryear, but rather something wonderful and lively. New concrete has been developed through research and invention that is more resilient, lighter, white or coloured, etc. Nearly all new problems have taught Concrete how to adapt. A Hungarian architect introduced the idea of transparent concrete for the first time in 2001. 80% of the light can pass through transparent concrete, which is 30% lighter than regular concrete. Precast panels are one option for it. It serves as a decorative component. On the outside of the panel, optical fibres are stacked in parallel, and the parallel configuration allows light to pass through. Heavy loads may be supported, and fibres cannot reduce the strength. The panels are constructed in a variety of sizes and shapes and are enclosed by an isolation that has the ability to stop.

1.1 LiTraCon (Light transmitting concrete)

1.LiTraCon (Light Transmitting Concrete) is a cement-based substance made up of water, fine particles, cement, and fibre optics.
2. Due of its pellucidity, it is also known as translucent concrete..
3.Since its widespread application in 1990, optical fibre is regarded as one of the greatest sensor materials now on the market.
4.Its ability to transmit light through thin concrete depends on the numerous strands of optical fibre that make up the material.
5.When litracon is used within a structure and is exposed to direct sunlight, it transmits the picture since it is not entirely transparent.
6. It's a novel method that's not like conventional concrete.
7.Translucent concrete, as opposed to traditional concrete, enables for lighter and less weight.
8. The optical fiber's thickness should be adjusted between 2 m and 2 mm, which is almost the same as the diameter of a human hair.
9.Optical fibre elements:-
• Core- The thin glass core of the fibre, through which light flows, is referred to as the core.
• Cladding- The outer optical layer that surrounds the core and reflects light back into it is called cladding. The refractive index of the core must be higher than that of the cladding in order to contain the reflection in the core.
• Buffer coating - This plastic layer shields the fibre from deterioration and moisture.
In the present work plastic optical fibres of 2mm diameter were used

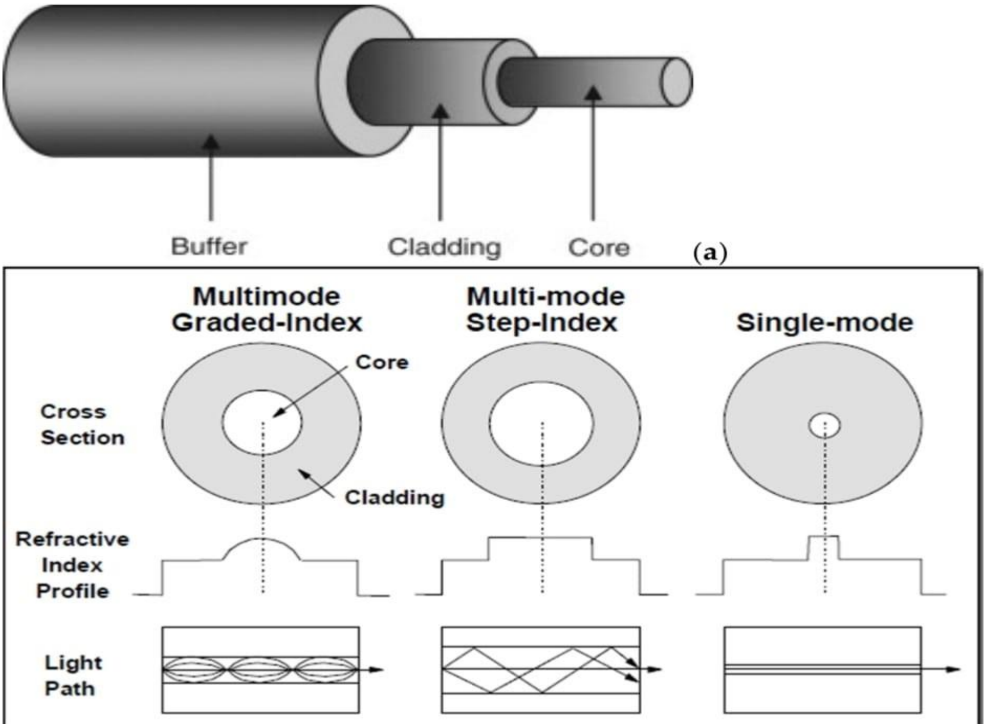

Fig 1. Optical fibre

1.2 Properties of optical fibres

Length : 20 meters
Diameter : 2mm
Aspect ratio : 100

1.3 History

Early in the 20th century, significant developments in polymer-based optical fibres gave rise to the idea of translucent concrete. Despite the fact that the notion of translucent concrete had been around for a while, Aron Losonczi, a Hungarian architect, first proposed it in 2001. Within two years of presenting his idea, Losonczi—the inventor of translucent concrete—was able to successfully create the first transparent concrete block. The name of this new substance was LiTraCon, or Light Transmitting Concrete, and it quickly gained acceptance in nations like Italy, Germany, and even China.

1.4 Advantages

- Ability of light transmittance
- Concrete that is transparent can be utilised in areas where light cannot enter effectively.
- Good aesthetic & architectural properties.
- Betterment in strength than conventional concrete.
- By using translucent concrete in construction, energy can be saved.
- Less energy consumption.

- Routine maintenance not required.

1.5 Disadvantages:

- The biggest drawback is that, as a result of the optical fibres, concrete is quite expensive..
- Special skilled persons are required.
- It is challenging to cast transparent concrete blocks.

2.2 mix proportion

Cement : Fine aggregate : Coarse aggregate : Water

487.62 : 443.41 : 925.98 : 181

1 : 0.90 : 1.90 : 0.37

Weight of materials	
Weight of cement	1.9kgs
Weight of fine aggregates	1.7kgs
Weight of coarse aggregates	3.6kgs
Water	181 ltr
Optical fibre is replacing by 3% of coarse aggregates	108gm

Table 1. Quantities of materials

2.3 preparation of LiTraCon

1-Preparation of the Mould:

Wood, steel, and a rectangular cross section measuring 150mm*150mm*150mm are used to create the mould. Create a rectangular mould of the desired size out of tin or wood. For simple demolding after the concreting, add clay or mud to the sides where the optical fibres are exposed to the mould.

2- Optical Fibre:
The optical fibres are precisely trimmed to the necessary mould size.
The most widely used optical fibre diameters are 2mm, 2.5mm, 5mm, and 7.5mm.

https://doi.org/10.1051/e3sconf/202339101206

3- Fixing the Fibres:

Fibres are arranged either in an organic pattern or a layered pattern. The wooden or steel plates have holes drilled into them so that optical fibres can flow through.

4- Concreting:

Without significantly disrupting the previously laid optical cables, Concrete that has been sufficiently mixed is carefully and softly poured. To avoid the formation of voids, the concrete is filled in thinner layers and stirred by compaction.

5- Removing the Mould:

Pull off the muck and mould once 24 hours have passed. On the levelled platform, the cast mould was left alone. Afterward, it was meticulously de-moulded after 24 hours from casting.

6- Cutting and polishing:

Cut the extra-long fibres to match the panel's thickness. Use polishing or sanding paper to smooth the panel's surface.

Fig 2. Preparation of mould

Fig 3. Concrete mixing

Fig 4. Fixing Optical fibre

Fig 5. Cutting and polishing

Fig 6. Light passing through LiTraCon

3 results

3.1 Properties of materials

1. Cement: All of the specimens were cast using regular Portland cement. The table below illustrates the crucial characteristics needed for translucent concrete.

Table 2. properties of cement

S.No	**Properties of cement**	**Values obtained**	**Standard limits**
1.	Fineness of cement as retained on 90-micron sieve	8%	<10%
2.	Grade of cement	53	----
3.	Specific gravity	3.11 g/cc	3.15g/cc
4.	Initial setting time	30min	30 min

2.Fine Aggregate: Sand used in fine aggregate is clear and dry. Sand that passes through a 1.18 mm sieve is used to cast each specimen. The table displays the values.

Table Properties of fine aggregates

S.No	Properties	Values obtained	Standard limits
1.	Specific gravity	2.53	2.5 to 3.0
2.	Fineness modulus	2.3	2.0 to 3.5

3. Coarse Aggregate: All specimens are cast using a 4.75mm sieve. The table below displays the key characteristics employed in transparent concrete.

Table 4.Properties of coarse aggregates

S.No	Properties	Values obtained	Standard limits
1	Size of aggregate	4.75mm	-
2.	Fineness modulus	7.1	6.9 to 7.5
3	Specific gravity	2.35	2.5 to 3.0

4. Results obtained from compressive strength.

Days	With fibre	Without fibre
7 Days	36 N/mm^2	23 N/mm^2
28 Days	51 N/mm^2	42 N/mm^2

4 Conclusions

1. The project's main emphasis was on intelligent building methods like green construction and internal aesthetic systems.
2. Utilising 3% more optical fibres resulted in an increase in compressive strength. The concrete cube's compressive strength is directly inversely proportional to the diameter of the holes in the mould and the diameter of the optical fibre.
3. According to the study, since optical fibres serve as fibre reinforcement, concrete can be transparent to light without sacrificing its compressive strength.
4. Its installation is expensive. However, the expense of routine maintenance is lower and may ultimately be beneficial. In actuality, it is priceless. Future price reductions are anticipated.

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