Economical and Sustainable Replacement for Optical Fibres in Translucent Concrete

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Abstract- The light transmitting concrete (LiTraCon) is a combination of opticalfibres, cement and fine aggregates. Saves energy by illuminating the indoors by daylight. Provides good aesthetical view to the building. Environment friendly by using reusable plastic wastes. To get the most economical and sustainable material that can be used as a replacement for plastic optical fibres in translucent concrete, pen refills are used. The main goal of this venture is to compare the compressive strength and luminous intensity of both plastic optical fibres and pen refills. Cubes were cast for M20 and tested for compressive strength at 7th day, 14th day, 28th day. Test outcomes will be obtained from the Compressive strength test.Also, the luminous intensity test will provide the comparative study on translucency of materials used.

keywords –light transmitting concrete, compressive strength, M20

I. INTRODUCTION

India consumes about 20% of total electrical energy for lighting the buildings. At present, green structures are greatly focusing on saving energy with indoor thermal systems. However, in area of illumination field, this project deals with a little research offering relevant solution to the environmental problem.When a solid wall is imbued with the ability to transmit light it means that a home can use fewer lights in their house during daylight hours so it is energy saving.

1.1 objectives:

1. Tocompare the compressive strength of the conventional concrete with the translucent concrete incorporated with optic fibres at the 7^{th} and 14^{th} day of the curing period.
2. To estimate the compressive strength of the conventional concrete with the translucent concrete incorporated with optic fibres at 28^{th} day of the curing period.
3. To analyze the compressive strength of the conventional concrete and translucent concrete infused with optic fibre.
4. To compare the luminous intensity of the translucent concrete using optic fibres and refill pens

1.*2 translucent concrete:*

Translucent concrete allows light to pass through it because of the presence of optical fibres within the opaque concrete wall. Light is transmitted from one surface of the said wall to the other, because of the presence of optical fibre strands along the width of the wall, which allows light to pass through. The principal objective of this project is to design translucent concrete blocks with the use of glass optical fibres, and then analyse their various properties and characteristics. All tests further performed on our concrete samples and on the optical fibres as such were done to ascertain the improvements of the casted blocks over conventional concrete blocks of the same size and with the same design ratios, and to ascertain the utility of using translucent concrete as a building material for green building development. LiTraCon presents the concept of light transmitting translucent concrete in the form of a widely applicable new building material.

1.3 How plastic optic fibres work:

Few strandsof optical filaments are arranged side by side on a concrete base leaving the light to transmit from one side to the other. Due to the small thickness of these filaments, they combine with the concrete.
It is a combination of optical fibres and fine concrete, combined in such a way that the material was both internally and externally homogeneous.

II. METHODOLOGY

2.1 *flowchart*

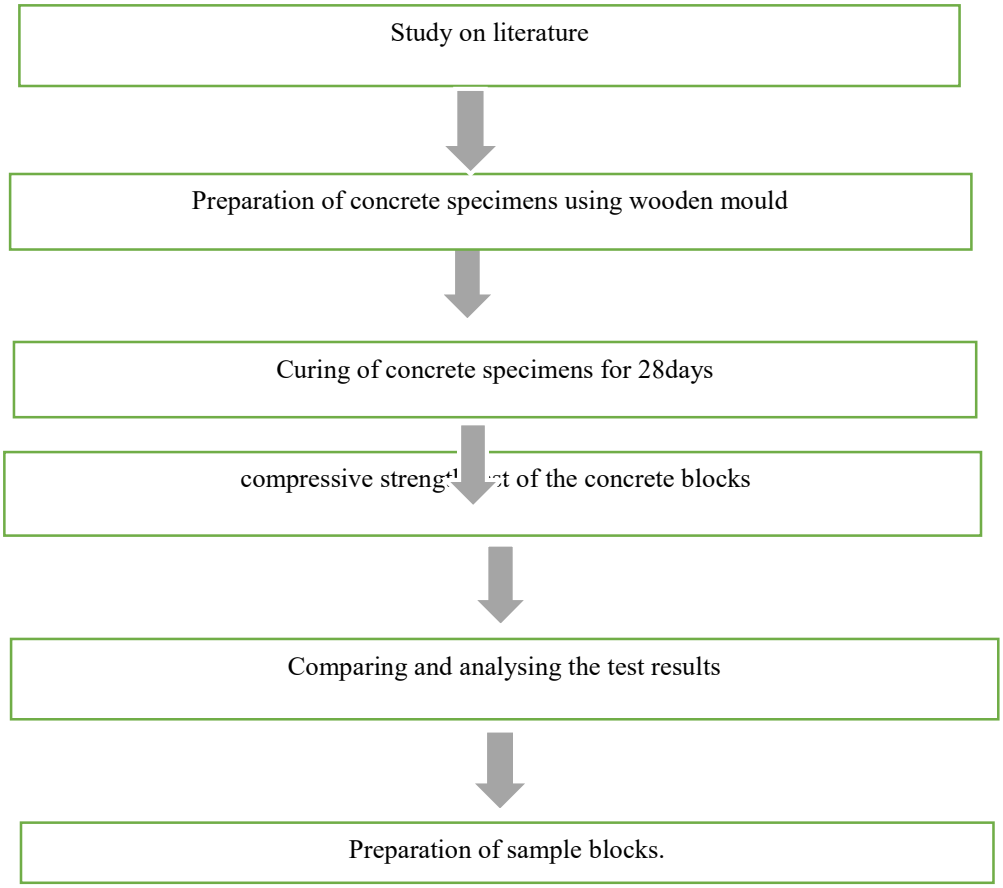


Figure 3.1:Flowchart representing the word

2.2Materials used :

2.2.1 Ordinary portland cement (OPC) :

Cement is the individual binding unit of fine and coarse aggregate into a solid mass by virtue of its inherent properties ofsetting or hardening and adhering to other materials in combination with water. It will help to fill the voids and gives density to the concrete. In this study, Ordinary Portland Cement-Grade 53, has been used for its rich quality and high durability. It is used for constructing bigger structures like building foundations, bridges, tall buildings, and structures design to withstand heavy pressure.

Table 2.21: General Test Results of CEMENT

S.NO	CHARACTERISTIC	RESULT
1	Specific Gravity	3.15
2	Initialsetting time(min)	40
3	Final setting time(min)	310
4	Consistency	31.5%

2.2.2 fine aggregate:

The influence of fine aggregates on the fresh properties of the concrete is significantly greater than that of coarse aggregate. The high volume of paste in concrete mixes helps inreducing the internal friction between the sand particles in the concrete but a good grain size distribution is still very important. Fine aggregates can be manufactured in industries ornatural. The grading must be uniform throughout the work and must pass through 2.36 mm sieve size according to the code IS: 383 – 1970. The fine aggregate has been tested for gradation, specific gravity and water absorption.

Table 2.2.2 : General Test Results of FINE AGGREGATE

S.NO.	CHARACTERISTIC	RESULT
1	Specific Gravity	2.31
2	Water absorption	2.33

2.2.*3 coarse aggregates:*

The coarse aggregate was liberated from clayey matter, silt and organic impurities. Coarse aggregate less than10mm nominal size is utilized in concrete. The coarse aggregate has also been tested for gradation, specificgravity and water absorption.

Table 2.2.3 : General Test Results of COARSE AGGREGATE

S.No.	CHARACTERISTIC	RESULT
1	Specific Gravity	2.56
2	Water absorption	2.56

2.2.4 plastic optical fibres:

Plastic optical fibre (POF) or Polymer optical fibre is made of polymer. Similar to glass optical fibre, POF transmits light through the core of the fibres.It consists of core, cladding material and buffer coating. Unlike glass, plastic fibres can easily be cut and bent to fit in hard-to-reach places and the larger core also allows for slightly damaged fibre to work. Few strands of plastic optical fibres each of diameter 0.75 mm is inserted for the manufacturing of translucent concrete.

2.2.5 pen refills:

Reusable pen refills of diameter 4 mm is used as replacement material for the manufacturing process of translucent concrete.The number of refills used depends on number of holed drilled in the mould.

2.2.6 water:

Water is the key ingredient, when mixed with the cement, forms a paste that binds the aggregate together. Waterutilized in concrete should be liberated from suspended solids, alkali, organic impurities etc., and it should meet the quality guidelines for making concrete or else, it adversely affects the strength of concrete. We have prepared concrete mix with the use of water cement ratio of 0.5.

III. CONCRETE MIX DESIGN

Mix design is the process of selecting suitable ingredients of concrete and in determining their relative proportions with the object of producing concrete of certain minimum strength and durability as economically as possible. The purpose of designing as can be seen is to achieve the stipulated strength and durability**.**The mix design for the specimens was done based on IS: 10262-2009. The water to cement ratio taken was 0.5

Table 3.1:Slump Cone Test Data

WATER CONTENT (ml)	WATER ADDED (ml)	HEIGHT OF SLUMP FROM THE BASE (cm)	SLUMP VALUE	REMARKS
0.45	594	30	0	True slump
0.5	660	16	14	Shear slump

Table 3.2:Material Specification

S.NO	MATERIAL	SPECIFICATION
1	Cement	Grade 53
2	Fine aggregate	Passing 2.36 mm Sieve
3	Coarse aggregate	Less than 10 mm diameter
4	Optical fibres	0.75 mm diameter strands
5	Pen refills	4 mm diameter
6	W/C Ratio	0.5

Table 3.3: Concrete Mix Proportion Data

Grade of concrete used: M20

CONCRETE MIX PROPORTION	FOR 1 m^3 OF CONCRETE	FOR 1 BATCH OF MIXING
Cement (kg)	441	0.456
Fine aggregate (kg)	598	0.632
Coarse aggregate (kg)	1060	1.12
Water (L)	220	0.232
W/C ratio	0.5	0.5

FIG 3.1:Placing ofOptic Fibres Onto The Wooden Mould

Fig 3.2:Placing of Pen Refills Onto The Wooden Mould

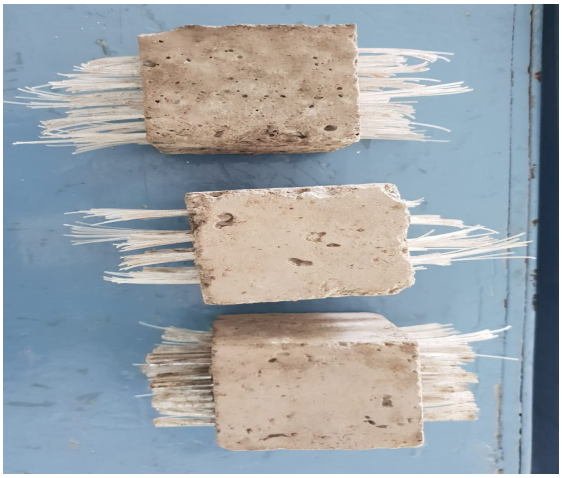
IV. MANUFACTURING PROCESS

The manufacturing process of translucent concrete is almost same as conventional concrete. Optical fibres and pen refills are spread throughout the aggregate and cement mix. Small layers of the concrete are poured on top of each other and infused with them and are then connected. Few strands of optical fibres or refills are cast into concrete to transmit light, either natural or artificial.

Light transmitting concrete is produced by adding required percentage of optical fibres by volume into the concrete mixture. Diameter of optical fibres of about 0.75 mm has been used.

Reusable pen refills of diameter 4mm has been inserted into the mould through holes. Number of refills used for manufacturing of these blocks depends on number of holes drilled.

Fibres or refills and concrete are alternately inserted into mould at appropriate intervals. A large amount of light will be transmitted through the thinner layers of the concrete. Following casting, the material surface is then typically polished resulting in finishes ranging from semi-gloss to high-gloss.



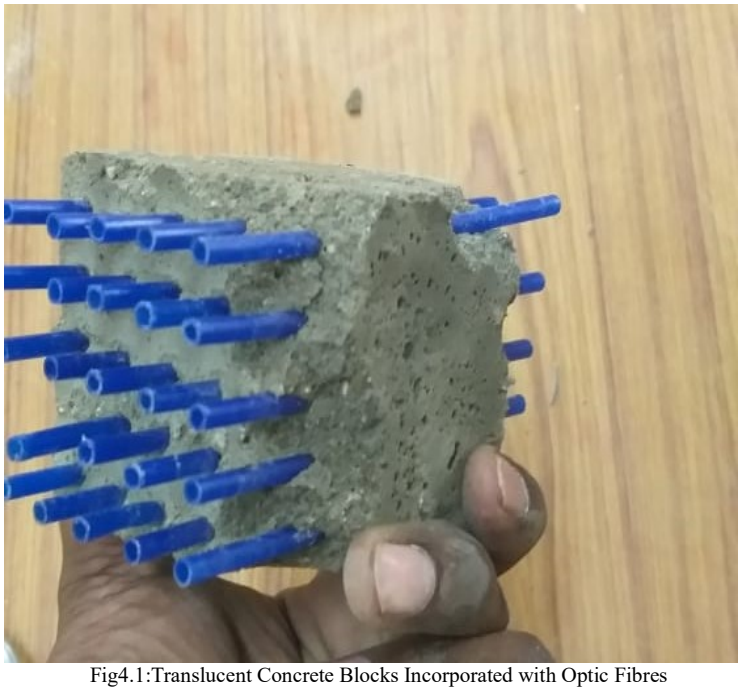


Fig4.1:Translucent Concrete Blocks Incorporated with Optic Fibres

Fig 4.2:Translucent Concrete Blocks Incorporated with Pen Refills

V.COMPRESSIVE STRENGTH TEST ON CONCRETE SPECIMEN

A compression test is a test where a material experiences limiting forces that drive inner upon the sample from inverse sides or is generally compacted, squashed, pounded, or fixed. The test is regularly set in two plates that fitting the associated load over the entire surface zone of two reverse faces of the test and subsequently, the plates are pushed together by a widespread test machine making the sample level. A compacted test is abbreviated toward the connected powers and grows toward the path opposite to the power. The purpose of this test is to choose the response of a material while it experiences a compressive load by assessing principal factors, for test, strain, stress, and twisting. Using this data, it is settled whether the material is appropriate for explicit applications.

VI.CONCLUSION

The compression strength test of the translucent concrete infused with optic fibres and the regular conventional concrete has been performed in the universal testing machine (UTM). The results are found to be identical. Both the conventional concrete and the translucent concrete has attained 65% and 90% of its design strength in the 7th day and 14th day in the curing course respectively. Therefore, the translucent concrete is proved to be optimum when compared with the regular concrete. The estimated compressive strength of the translucent concrete using refill of the pens and the optic fibres at the 28th day of its curing period and the compressive strength of the conventional concrete and the translucent concrete are furnished below.

COMPRESSIVE STRENGTH TEST RESULTS:

S.NO	LOAD (KN)	STRESS (MPa)
Sample 1	67	13.68
Sample 2	61.29	12.51
Sample 3	43	8.78

Table 6.1: Compressive Strength of The Conventional Concrete At 7th Day

S.NO	LOAD(KN)	STRESS (MPa)
Sample 1	106.28	21.69
Sample 2	86.63	17.68
sample 3	107.31	21.9

Table 6.2: Compressive Strength of The Conventional Concrete at 14th Day

S,NO	LOAD (KN)	STRESS (MPa)
Sample 1	115.8	23.64
Sample 2	116.96	23.87
sample 3	109.12	22.27

Fig 6.3 EstimatedCompressive Strength of The Conventional Concrete At 28th Day

S.NO	LOAD(KN)	STRESS (MPa)
Sample 1	64.9	13.03
Sample 2	59.4	11.92
Sample 3	41.7	8.37

Table 6.4: Compressive Strength of The Concrete Blocks Incorporated with Optical Fibre at 7thDay.

S.NO	LOAD (KN)	STRESS (MPa)
Sample 1	102.9	20.66
Sample 2	83.9	16.84
Sample 3	104.1	20.90

Table6.5 : Compressive Strength Of The Concrete Blocks Incorporated With Optic Fibre at 14th Day

S.NO	LOAD (KN)	STRESS (MPa)
Sample 1	115.2	23.51
Sample 2	111.62	22.78
sample 3	104.64	21.35

Table6.6: Estimated Compressive Strength of The Concrete Blocks Incorporated with Optic Fibre at 28th Day

VII. SCOPE

The project rests with the completion of determining the compressive strength for 7th and 14th day of the conventional concrete and the concrete specimens incorporated with optic fibres. It also helps in estimating the compressive strength for 28th day of both conventional concrete and concrete specimens incorporated with optic fibres. The project can be advanced by determining the compressive strength of the concrete blocks infused with refill of the pens, optic fibre and the conventional concrete for the 28th day. The following results can be compared to work out the strength of the conventional concrete and the concrete blocks infused with optic fibres and refill of the pens and can be further proceeded with determining the luminance intensity of the translucent concrete integrated with refill of the pens and the optic fibres using LUX METER to figure out the best economic way which can be used in the future.

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