Scientific Journal of Impact Factor (SJIF): 5.71

e-ISSN (O): 2348-4470
p-ISSN (P): 2348-6406

International Journal of Advance Engineering and Research Development

Volume 5, Issue 05, May -2018

LIGHT TRANSMITTING CONCRETE USING PLASTIC BOTTLE GLASSES AND CLEAR CASTING RESIN

Guddu Kumar Singh [1], Shivam Singh [2]

1, 2 U.G. Scholar
Department of Civil Engineering, Buddha Institute of Technology, GIDA, Gorakhpur (INDIA)

Abstract - *Light transmitting concrete made by plastic bottle filled with chlorinated water and clear casting resin is concrete based building material which can transmit light through concrete. Waste plastic bottle is coated with Clear casting resin on to the surface facing sun and bottle is filled with chlorinated water are utilized to prepare light transmitting concrete that works very effectively as energy saving construction material in interiors of concrete structures by utilizing sunlight for illumination and also reduces the total dead load of concrete structures on the foundation in very less cost using natural resources. To reduce the quantity and volume of cement, sand and aggregate in regular concrete M20 mix, with that in the mind experiments were conducted. This research included the manufacturing of concrete mix which is 1cement: 1.5 sand: 3 Aggregate aided with plastic bottle filled with chlorinated water and clear casting resin and light transmitting concrete cubes are casted. After manufacturing of cube the various test is carried out to determine the compressive strength , transmissibility of light and flexural strength test in accordance with IS-456, IS-3370. The light transmitting concrete blocks are of volume 150mm×150mm×150mm.*

Keywords *- Admixture, Aluminum resin mold, Cement, Clear casting resin, Hardener, sand, Plastic bottle filled with chlorinated water.*

I. INTRODUCTION

Sometimes ago concrete was usually misunderstood and hated as building material by its characteristics fixed due to fast globalization in 20th century. Now concrete is making excellent development not only technically, but also aesthetically. It has now light in weight and no longer the heavy, boring and gray material of the 20th century. It has becoming aesthetically more good and lively. By various researches and innovations, newly prepared concrete have been made which is very resistant, light in weight and effective also. In 2001, initially the concept for the transparent concrete was made by Hungarian architect Aronlosonzi and transparent concrete blocks were successfully prepared, this innovation utilized optical fiber for transparency. But the uses of optical fiber increases the investment needed for manufacturing of light transmitting concrete. So this transparent concrete becomes uneconomical and inconvenient both. Light Transmitting concrete is the outcome of researches which uses the solar radiations to enter in the interior part of the building constructions and also used for architectural purpose also. Creating an environment which depends on the local resources; that is not expected to be ended in life-cycle would be a tremendous change towards the environment for the new generation and light transmitting concrete is all about it. Our research paper on the light transmitting concrete aims to utilize the great amount of potential energy of solar radiations and optimize the waste plastic glasses. While approaching towards materials which can provide more strength than that regular concrete we started to manufacturing the light transmitting concrete .This light transmitting concrete is manufactured by waste plastic glasses and clear casting resin. Light weight of concrete cube is achieved by removing concrete components at predetermined extent and transparency of light is achieved by using plastic waste glasses and clear casting resin .Light transmitting concrete can be applied in the interior and exterior walls, slabs, floors, and partition walls everywhere regular concrete is applied. By embedding plastic bottle glasses and clear casting resin light can be emitted from outside to inside and this concrete is highly effective as total incoming light get transmitted through plastic bottle glasses and clear casting resin medium. A wall made with light transmitting concrete has very high strength than regular concrete and embedded array of lightening sources can display the scenario of outside world with clarity.

II. SIGNIFICANCE OF PROJECT

1- To prepare light transmitting concrete for aesthetically pleasing by transmission of light through its surface.
2- **To** make Light transmitting concrete by plastic bottle glasses and clear casting resin for transparency which is relatively cheaper than translucent concrete prepared by optical fiber.
3- To use sunlight for illumination in the interiors of concrete building.
4- To develop another method to acquire permanent energy by sun radiation for lightening.
5- To reduce the dead weight of concrete that is further transferred on the foundation of concrete building.

III. MATERIALS

3.1 Cement

Portland pozzolana cement (as specified in Indian Standard code of practice 4031-1988 and 1489-1991(Part 1 and 2)) is used for our testing purpose and the following properties is found out as per table 3.1.1

Table 1 Physical properties

S. No.	Property		Observed average value	Expected value
1	Specific gravity		3.13	≅ 3.15
2	Fineness modulus test		2.5%	≤5%
3	Normal consistency		30.0%	25 to 38 %
4	Soundness		2.0 mm	$\leq 10\ mm$
5	Initial setting time		32 min	$\geq 30\ min$
6	Final setting time		570 min	$\leq 600\ min$
7	Compressive strength (in N/mm^2)	3^{rd} day	13.30	≥ 33 N/mm^2
		7^{th} day	23.60	
		14^{th} day	34.50	
		28^{th} day	53.60	

3.2 Aggregate

3.2.1 Fine aggregate:-

Fine aggregate which is purchased and used in testing for this special concrete pauses following properties according to table-3.2.1.1 and the sand conforms to zone II as per the specifications of IS 383:1970.

Table 2 Properties of fine aggregate

S. No.	Property	Observed average value	Expected value
1	Specific gravity	2.630	≅ 2.70
2	Silt content	1.17 %	≤ 6%
3	Bulking of sand	1.75	---

3.2.2 Coarse aggregate:-

20mm nominal maximum size of coarse aggregate is used for the preparation of concrete and the sieve analysis of combined aggregates confirms to the specifications of IS 383: 1970 for graded aggregates. Coarse aggregate have following properties according to table-3.2.2.1

Table 3 Properties of coarse aggregate

S. No.	Property	Observed average value	Expected value
1	Specific gravity	2.710	≅ 2.70
2	Water absorption	2.60 %	≤ 6%
3	Flakiness index (F.I.)	0.89%	≤ 10 *to* 15%
4	Elongation index (E.I.)	2.0%	4 to 5 times of F.I.

3.3 Water:-

Property of water have greater impact on to the concrete, thus the water which is used for the preparation of the concrete have contains following properties according to table-3.3.1

Table 4 Water quality

S. No.	Property	Observed average value	Expected value
1	pH value	7.0	6.5 to 7.5
2	Organic content	0.0 ppm	$\leq 200\ ppm$
3	Inorganic content	110.67 ppm	$\leq 3000\ ppm$
4	Sulfate content	2.4 ppm	$\leq 400\ ppm$
5	Total suspended matter	182 ppm	$\leq 2000\ ppm$
6	Chloride content	13.34 ppm	$\leq 2000\ ppm\ or\ 500\ ppm$

3.4 Clear casting resin (CCR)

- For the transmission of light through concrete and reduction of total dead weight clear casting resin is used.
- It possess high abrasive strength and hardness (on Barcol scale 38 – 42) thus coted on the plastic bottle facing from sun direction.
- The properties of CCR is listed in table 3.4.1 and 3.4.2.

Table 5 CCR properties

S. No.	Property	ASTM Test method	Results in M-Pa
1	FLEXURAL STRENGTH	D-790	91
2	FLEXURAL MODULUS	D-790	5048
3	TENSILE STRENGTH	D-638	44
4	TENSILE MODULUS	D-638	4945
5	TENSILE ELONGATION, %	D-638	1.5
6	Heat Distortion Temperature	D-648	115 °F / 46.1 °C
7	Hardness, Barcol 934-1	D-2583	38 – 42
8	Refractive Index	1.52	

Table 6 CCR properties related to production

S. No.	TYPICAL RESIN PROPERTIES @ 77°F RESULTS	
1	Catalyst %	1.0
2	Gel Time, (min.: sec.)	14:00 – 25:00
3	Gel to Peak Time, (min.: sec.)	35:00 – 60:00

3.5 Mix design for M-20 Grade Concrete

- Target Minimum Compressive Strength after 28 days: 20 N/mm^2
- Type of Exposure: Severe

3.6 Plastic bottles filled with chlorinated water

Waste plastic bottle is utilize to minimize plastic waste and clear plastic bottle have good refractive index nearly equal to the clear casting resin, thus more light can be achieved through light transmission. Waste plastic bottle is found out of following properties according to table no.

Table 7 Specification of specials

Material	S. No.	Description	Property
Properties of plastic bottle containing chlorinated water	**1**	Bottle color	Colorless
	2	Bottle water sealing	Good quality
	3	Water	Turbid less and colorless
	4	Residual Chlorine	1.0 ppm
	5	Compressive strength	55 N/mm^2

IV. MANUFACTURING PROCESS

Light transmitting concrete is made of cement, sand, aggregate, plastic bottle filled with chlorinated water and clear casting resin. The manufacturing process of Light transmitting concrete is just same as the manufacturing of regular concrete. As per advancement of this research, in this manufacturing process plastic bottle filled with chlorinated water and clear casting resin medium is inserted in this manufacturing process. Due to plastic bottle filled with chlorinated water and clear casting resin, strength and consistency of light transmitting concrete are greater than the regular concrete as calculated in tests results. Almost free energy loss by light transmission through plastic bottle filled with chlorinated water and clear casting resin make the possibility to see light array and even different colors through Light transmitting concrete even by very thicker wall. In this way, the resultant is like solid glass in concrete as new building material, which is uniform in its interior structure as well as on its outer surfaces. The plastic bottle filled with chlorinated water and clear casting resin leads light passed between the two sides of the Light transmitting concrete blocks. Due to of their proper arrangement inside the concrete, the light striking on the outer side of wall appears unchanged on the inner side and there is similarity in outside light and interior of structure. Use of clear casting resin and plastic bottle filled with chlorinated water enhances the strength of concrete as it possesses relatively high strength of 91 N/mm^2. Moreover, the color of the light also remains same as it does not get dispersed in resin and glass medium. Clear casting resin is in liquid state until it is mixture with the hardener .Once the hardener is mixed in plastic bottle filled with chlorinated water, it will take time in 2-4 hours to be settled like solid filled glass. Therefore its manufacturing is completed before the casting of concrete and further it is fixed in the concrete-mold and concrete is placed by fixing the clear casting resin in concrete mold. Water to Cement ratio (w/c) is managed 0.50 in this light transmitting concrete mix.

4.1 Test conducted on concrete:-There are three types of test in concrete-

1- Workability
2- Compressive strength test
3- Flexural strength test

4.1.1 Workability

The workability of light transmitting concrete is determined by conducting slump test and compaction factor test.

Table 8 Workability test results

S. No.	Characteristics	Test result	
		Slump (in mm)	Compaction factor
1	Workability test	90	0.92

4.1.2 Compressive Strength Test

- The strength after 28 days of casting of concrete cubes at which concrete sample fails under uniaxial compression test is the ultimate characteristic compressive strength.
- The compressive strength is determined by compressive strength test (CST) which is performed on the compressive strength testing machine.
- Concrete cubes of 150mm×150mm×150mm size are casted for the CST.

$$Compressivestrength = \frac{Load}{Area}$$

Table 9 Test Result

Test day	Observed Compressive strength (in N/mm^2)			
	Ordinary concrete	Light Transmitting concrete	Clear Casting resin	Plastic bottle completely filled with chlorinated water
0th day	0	0	91	55
3rd day	8	12.9	91	55
7th day	13.5	17	91	55
14th day	18	23.46	91	55
28th day	20	28.78	91	55

4.1.3 Flexural Strength Test

Flexural strength of light transmitting concrete is determined by conducting test on Universal Testing Machine (UTM). The stress induced in concrete beam just before yielding is known as flexural strength of concrete.

$$Flexural\ strength = \frac{3Pl}{2bd^2}$$

Where, P =Applied load, b=width, d=depth, l=length

Test Result:-Flexural strength of light transmitting concrete = 9.10N/mm^2

V. CONCLUSION

1. Plastic bottles glasses utilized in the making of light transmitting concrete. It make environment free of contaminants as plastic bottle glasses get wasted in huge quantity and pollutes environment.
2. Light transmitting concrete was manufactured using different material clear casting resin to achieve transparency.
3. Light transmitting concrete would be very effective in daytime for high rise building.
4. Light transmission and mechanical properties through this concrete were investigated and the hypothesis of light transmission is verified. Plastic bottle glasses and clear casting resin based concrete allow the use of light for illumination in interiors.
5. It is concluded that on utilization of plastic bottle glasses and clear casting resin, the compressive strength is increased as plastic bottle glasses and clear casting resin possess higher strength than regular concrete.
6. Conclusion of this research, transparency in concrete is achievable without any compromise with strength criteria.

REFERENCES

[1] "An Experimental Work On Light transmitting concrete", by Anurag Shukla, Trushik Poriya ; International journal of Advance Engineering and Research Development (IJAERD) Volume 1, Issue 5,2014.
[2] "Study of smart Transparent Concrete products and it's Performance", by Jianpiang He,Zhi Zhou, Jingping Ou,2011.
[3] Recommended Guidelines for Mix Design of Concrete (IS: 10262-1992).
[4] Indian Standard Plain and Reinforced Concrete- Code of Practice (IS: 456-2000).
[5] IS: 1489-1991(Part 1 and 2) and IS: 4031-1988.

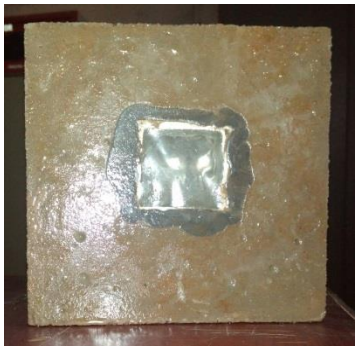

Figure 1 ***Light transmitting concrete***

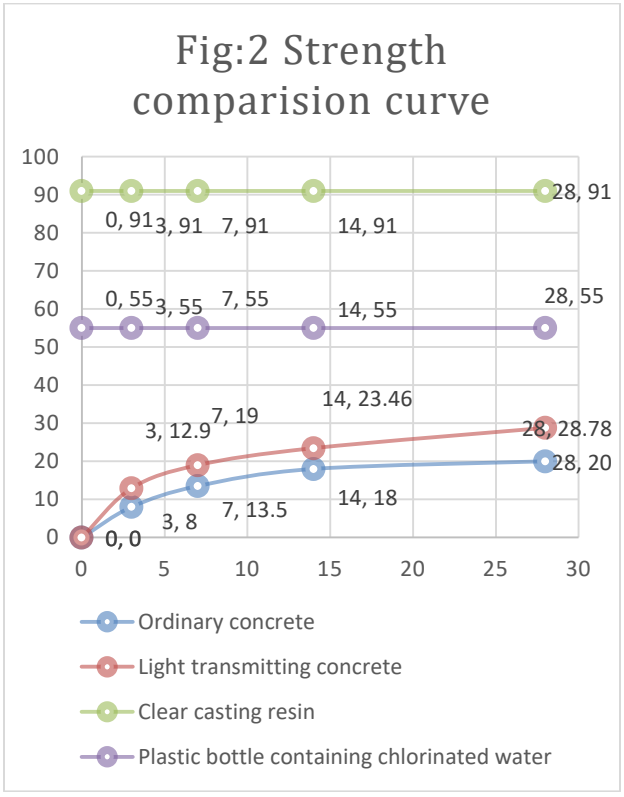

Figure 2 ***Strength comparison curve***

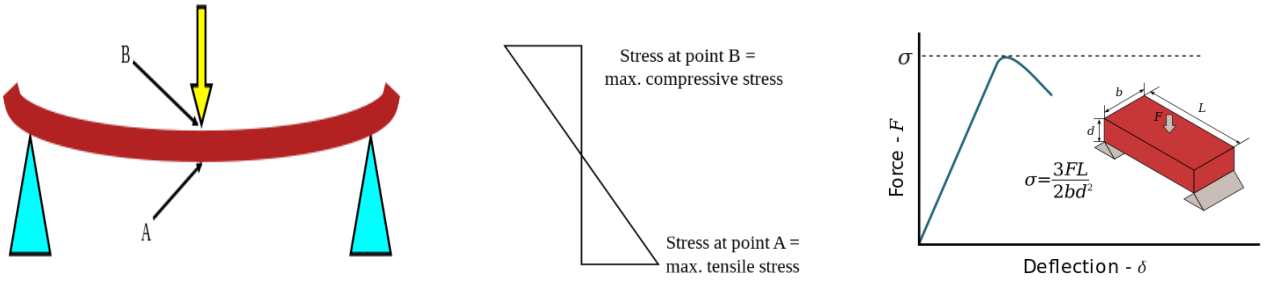

Figure 3 Flexural strength testing beam

