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Light transmitting concrete using clear casting resin

Shivam Singh [1], Guddu Kumar Singh [2], Devesh Singh[3], BhupatiKumar Mishra[4],AnilPratap Singh[5], Sabya Gupta[6] , Anuradha Sharma[7]

[1,2,3,4]U.G. Scholar,[5]Assistant professor,CE

Department of Civil Engineering,Buddha Institute of Technology,GIDA, Gorakhpur (India)

ABSTRACT

Light transmitting concrete is concrete based construction material which transmits embedding light through concrete. Clear casting resin is utilized to make light transmitting concrete that serves very effectively as energy saving in interiors of building by using sunlight and also reduces the total dead load of building on the foundation in very low cost using natural resources. To replace some part of aggregate in regular concrete M20 mix, with that in the mind a research was conducted. This research involved the preparation of concrete mix which is 1cement: 1.5 sand: 3Aggregate and concrete blocks are casted. After casting, the test is performed to know the compressive strength, Light transmission, flexural strength test in according with IS-456, IS-3370. The concrete blocks are of volume 150mm×150mm×150mm.

Keywords:Admixture, Aluminum wire-mold,Cement, Clear casting resin, Hardener, sand.

I.INTRODUCTION

Some decades ago concrete was usually misunderstood and disliked as construction material by its image fixed due fast urbanization in 20th century. Now concrete is making significant progress not only technically, but also aesthetically. It becomes light and no longer the heavy, unpleasing and gray material of the past time. It has become aesthetically good and lively. By various researches and innovations, newly casted concrete have been made which is more resistant, light weight and effective etc. In 2001, first of all the concept for the transparency of concrete was introduced by Hungarian architect Aronlosonziand first transparent concrete block was successfully casted, this research uses optical fiber as transparent material. But this optical fiber increases the cost of light transmitting concrete. So the concrete becomes uneconomical. Transparent concrete is the consequence of researches which utilizes the sunlight to emit in the internal part of the building constructions and also used as fine architecture too. Building an environment which depends on the natural resources; which is not expected to be finish in life-cycle will be a great change towards the atmosphere for the upcoming generation and light transmitting concrete is all about it. Our research paper on the use of light transmitting concrete desires to utilize the high amount of potential energy of sunlight. While approaching towards a material which can give more strength than that general concrete we decided to make light transmitting concrete .This light transmitting concrete is made by clear casting resin. Light weight is achieved by removing concrete at predetermined extent and light transparency is achieved by using clear casting resin .It can be used for interior and exterior walls, slabs, floor, and partition walls everywhere general concrete is used. By embedding clear

casting resin light can be transmitted from outside to inside and this concrete is very efficient as total incoming light get transmitted through clear casting resin medium. A wall made with light transmitting concrete has more strength than traditional concrete and embedded array of resin can display the scenario of outside world with clarity.

II.SIGNIFICANCE OF PROJECT

1- To make concrete for aesthetically pleasing by light transmitting through its surface.

2- To prepare light transmitting concrete by clear casting resin for transparency which is relatively cheaper than concrete prepared by using optical fiber.

3- To use sunlight for illumination in the interior parts of building.

4- To invent another technique for acquiring non-conventional energy by using sun radiation for lightening purpose.

5- To check whether the embedding of clear casting resin enhancing the engineering properties of concrete or not.

6- To reduce the total dead weight of concrete which is further applied on foundation of building.

III.MATERIALS

3.1 Cement

Cement consumed in the experimental process is Portland pozzolana cement (as specified in Indian Standard code of practice 4031-1988 and 1489-1991(Part 1 and 2)).

3.1.1Physical properties

Table I.

S. NO	CHARACTERISTICS	TEST RESULT	STANDARD RESULT(as per IS CODE)
1.	Consistency	30%	30% to 38%
2.	Initial Setting Time	32min	Not less than 30 min
3.	Final Setting time	570min	Not more than 600 min
4.	Specific Gravity	3.156	3.15
5.	Fineness Modulus	2.5%	Not more than 5%
6.	Compressive Strength	53.6N/mm^2	Not less than 43N/mm2

3.2 Fine aggregate

Fine aggregate was purchased which satisfied the required properties of fine aggregate required for experimental work and the sand conforms to zone II as per the specifications of IS 383:1970.

3.2.1 Properties

Table II.

S. No.	CHARACTERISTICS	TEST RESULT
1.	Specific gravity	2.63
2.	Fineness modulus	2.84
3.	Silt content	2.63

3.3Coarse aggregate

The crushed aggregates used were 20mm nominal maximum size. The sieve analysis of combined aggregates confirms to the specifications of IS 383: 1970 for graded aggregates

3.3.1 Properties

Table III.

S. No.	CHARACTERISTICS	TEST RESULT
1.	Specific gravity	2.71
2.	Fineness Modulus	6.814

3.4 Water

Mixing water should not contain undesirable organic substances or inorganic constituents in excessive proportions. In this project clean potable water is used.

3.5 Clear casting resin

- Clear casting resin used for the reducing the total dead weight and transparency of our concrete.
- Compressive Strength of clear casting resin is 91N/mm^2.

3.6 Mix design for M-20 Grade Concrete

- Characteristic Compressive Strength required at the end of 28 days: 20 N/mm^2
- Maximum size of Aggregate: 20mm
- Type of Exposure: Severe

3.7 Test Data for Materials

Table IV.

S. No.	CHARACTERISTICS	TEST RESULT
1.	Specific Gravity of Cement	3.157
2.	Specific Gravity of Coarse Aggregate	2.70
3.	Specific Gravity of Fine Aggregate	2.62

IV.MANUFACTURING PROCESS

Light transmitting concrete is made of cement, sand, aggregate and clear casting resin. The manufacturing process of Light transmitting concrete is very similar as manufacturing of traditional concrete. Additionally in

this manufacturing process clear casting resin medium is inserted. Due to clear casting resin,strength and consistency of

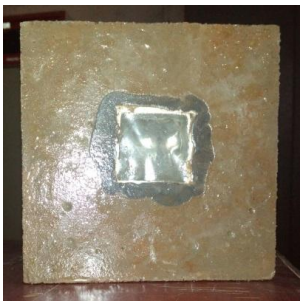


Fig:1 Light transmitting concrete

light transmitting concrete are higher than the traditional concrete as explained in tests results. Almost free energy loss by light transmission through clear casting resin makes 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 construction material, which is uniform in its interior structure as well as on its outer surfaces. The clear casting resin leads light passed between the two sides of the Light transmitting concrete blocks.Due to of their arrangement in concrete, the light striking on the shining side of wall appears unchanged on the other side and there is similarityof outside light and interior of structure. Use of clear casting resin enhances the strength of concrete as it possesses relatively high strength of 91 N/mm^2. Moreover, the color of the light also remains similar as it does not get dispersed in resin medium. Clear casting resin is in liquid form until it is mixed with the hardener .Once the hardener is mixed in Aluminum wire-mold it takes time in hours to be settled like solid glass. Therefore its casting is done before the casting of concrete and finally it is kept in the mold and concrete is placed by fixing the clear casting resin in concrete mold. Water to Cement ratio (w/c) is kept 0.50 in the 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 V. Test Result

S. No.	CHARACTERISTICS	TEST RESULT	
		Slump (in mm)	Compaction factor
1	Workability test	90	0.91

4.1.2 Compressive Strength Test

- By definition compressive strength of concrete is that value of uniaxial compressive stress obtained, when the material fails entirely.
- The compressive strength is determined by compressive strength test. The compressive strength test.
- The compressive strength of cube size 150mm150mm×150mm by casting.

$$F / A_c = f_c \quad (1)$$

Where, F = compressive force, Ac = cross sectional area under compression and f_c =compressive stress.

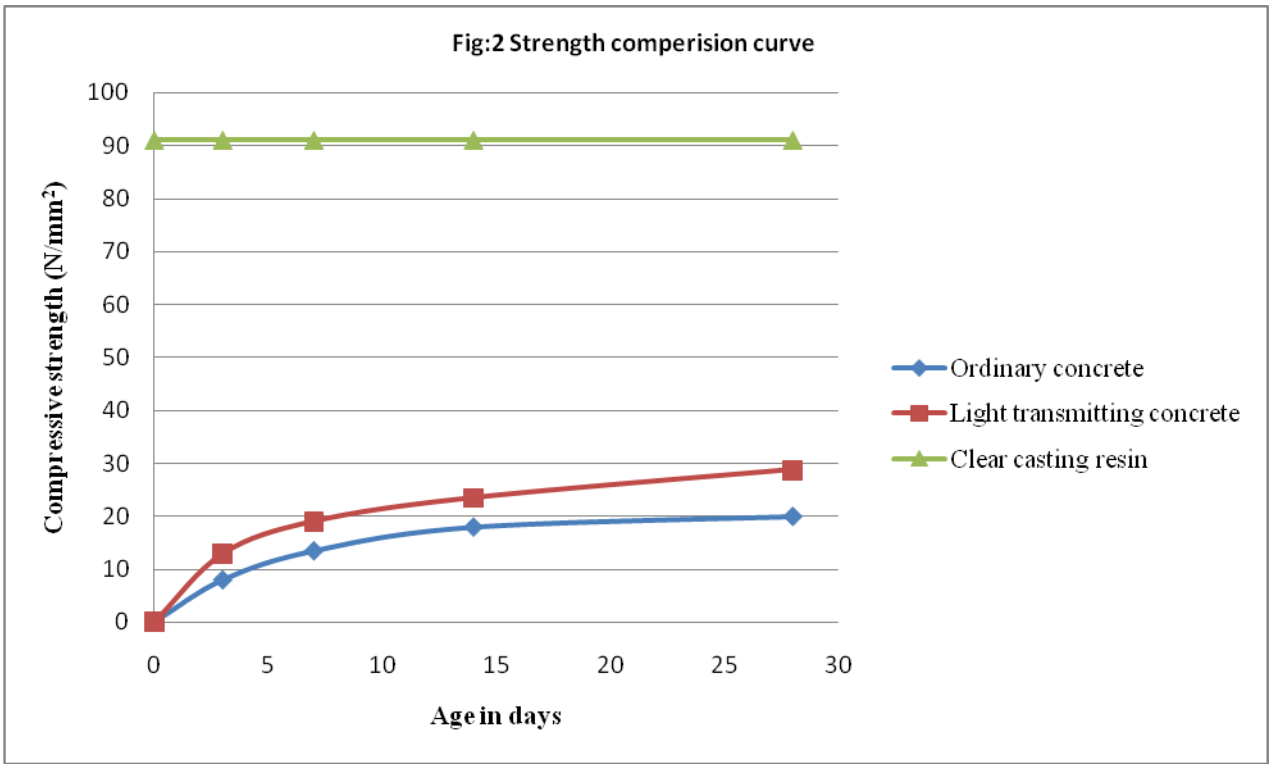


Table VI. Test Result

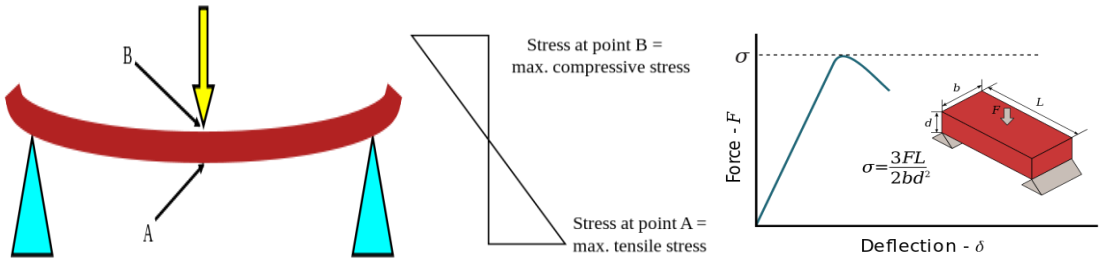
Test day	Ordinary concrete	Light Transmitting concrete	Casting resin
0th day	0	0	91
3rd day	8	12.9	91
7th day	13.5	17	91
14th day	18	23.46	91
28th day	20	28.78	91

4.1.3 Flexural Strength Test

Flexural strength of light transmitting concrete is determined by conducting test on UTM. Flexural strength of concrete is defined as stress in concrete just before yields in flexural strength test.

$$(3Pl) / (2bd^2) = f_{cbc} \qquad (2)$$

Where, P =Applied load, b=width, d=depth, l=length and f_{cbc} = flexural strength



Test Result

Flexural strength of light transmitting concrete = 9.2N/mm^2

4.2 Strength of Clear casting resin

The properties of clear casting resin were mentioned on the packet purchased from market which is shown in table.

Property:	ASTM Test Method	Psi	Mpa
Flexural Strength	D-790	13,200	91
Flexural Modulus	D-790	7.32 x 105	5048
Tensile Strength	D-638	6,400	44
Tensile Modulus	D-638	7.17 x 105	4945
Tensile Elongation, %	D-638	1.5	1.5
Heat Distortion Temperature	D-648	115 °F / 46.1 °C	
Hardness, Barcol 934-1	D-2583	38 - 42	

V. COMPARISON BETWEEN ORDINARY CONCRETE AND LIGHT TRANSMITTING CONCRETE

Table VII.

S. No.	Light transmitting concrete (average wt.)	Ordinary concrete (average wt.)
1	7.50 kg	8.4 kg

VI.CONCLUSION

1. Light transmitting concrete was made by using clear casting resin which is very different material formanufacturing of concrete.
2. Transmission of light, mechanical properties was investigated and the hypothesis of light transmission was confirmed. Clear casting resin based concrete allow the use of light for illumination.
3. Light transmitting concrete will be very beneficial in daytime for skyscraper.
4. Light transmitting concrete made by clear casting resin is also aesthetically pleasing and it could be considered as an art rather than just as a construction material.
5. It is concluded that on usage of clear casting resin, the compressive strength increased as clear casting resin also possess higher strength than traditional concrete.
6. The study concludes that the transparency of concrete is achievable to make without affecting its compressive strength.

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[3]IS:4031-1988, 1489-1991(Part 1 and 2) and IS 383:1970.

[4]IS: 10262-1992 recommended guidelines for mix design of concrete.

[5]IS: 456-2000: Indian Standard Plain and Reinforced Concrete- Code of Practice.