International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

An Experimental Study on Efficiency & Cost Analysis of Pellucid Concrete

Suhail Shabir[1], Ajay Vikram[2]

[1,2]Department of Structural Engineering, Rayat Bahra University Mohali, punjab

ABSTRACT

Pellucid concrete is a concrete based material with light transmitting properties, which is obtained by using plastic optical fibre in it. Light is transmitted through the fibre from one end to another end which results into a lighting pattern on the other surface, depending on the fibre diameter and percentage used. Plastic optical fibres transmit light so effectively that there is virtually zero percent loss of light. Use of pellucid concrete increases the visual appearance of the structure but there is a little increase in the cost of structure. Optical fibre of diameter 0.2 mm and 0.5mm is used in this study. The amount of optical fibre used is 0.5%, 1%, 1.5%, and 2% by weight of cement. Experiments which shows the behavior of pellucid concrete that were carried out to check its properties i.e. compressive strength, flexural strength, light transmission & workability are compression test, flexure test, slump test and light transmission test. While performing experiments fibre were placed parallel as well as perpendicular to the load applied, so as to check the compressive strength in both forms.

Compressive strength increased continuously in parallel loading with major strength change on addition of 1% plastic optical fibre, while in perpendicular loading it decreased after 1% use of plastic optical fibre. Flexural strength also increased continuously but major change was seen on addition of 1% plastic optical fibre.

To check light transmission through pellucid blocks, light transmission test was carried with the help of Lux metre. Cost analysis has also been done in this study, to check whether cost of pellucid concrete increases or decreases.

Keywords: Translucent,optical fibers, pigments, light transmitting, CTM

INTRODUCTION

Civil engineering has achieved advancement in the field of construction, few people were having misconception about civil engineering as a branch of science which deals with civilization. But, when the time passes the construction of engineering structures, like underground roads, bridge, elevated road, landmark buildings, skyscrapers and many other building structure have taken place. While considering economic growth, in this time there is an extensive growth that is why high consumption and high pollution. So the time has come when this modern world should have energy saving technologies practically in developing countries. Dealing with the external structure that are prone to external environmental effects like rain, snow, wind, storms and chemical action on structures cause economic losses and some serious casualties once damaged. Keeping all these things into one's mind engineers are trying to build structures that should include, self diagnose smart concrete, self compacting concrete, self lining smart concrete, soundproof concrete, self repairing and so on. All these are economic characters

but cannot posses energy saving. For energy saving a different material known as Pellucid concrete is developed, which can impart a different feature in concrete and has energy saving as well as economical. The pellucid concrete has the ability to transmit light, so it can be said that it is a light emitting concrete. Pellucid concrete is the only revolutionary material that was marketed as Litron. The pellucid concrete was first developed in 2001 by Hungarian architect Aron Losonezi at the technical university of Budapest. Pellucid concrete can be precast blocks of different size. In pellucid concrete, which is commonly known as transparent concrete, optical fibre are casted into concrete to transmit light, either naturally or artificially through pellucid panel. The fibre concrete runs parallel to each other so light between the two surfaces of concrete embedded together. It has two major components which are used in construction & sensing.
Concrete is commonly used material in civil engineering which is an advantage of rich raw materials, low cost and simple production process and optical fibre has good light guiding which can transmit sunlight according to predesign road without light-heat, light-electrical or photo chemical process. While combining the advantages of both concrete and optical fibre, that has a functional material, with important value of application for construction and sensing.

OBJECTIVES

1.1 General

Sunlight can be helpful for buildings, if the walls are made up of pellucid concrete which illuminates it from natural sunlight. Pellucid concrete has the property to impart a different feature in concrete, which is energy saving as well as economical. The building can be declared green building if pellucid concrete is used in its construction, because it saves lot of electricity & is eco-friendly.

Objectives

In this present work plastic optical fibre is used to form pellucid concrete and to compare/analyze its different properties i.e. compressive strength, flexural strength, light transmission with respect to conventional concrete by performing following test.

- Compression test on compression testing machine (CTM).
- Flexure test on flexural testing machine (UTM).
- Workability test with slump cone.
- Light Transmission test with the help of Lux metre.
- Cost analysis with respect to conventional concrete.

DISCUSSION

Pellucid concrete, also known as translucent or transparent concrete, is an innovative building material that allows light to pass through its structure by incorporating light-transmitting elements such as optical fibers. This unique property not only enhances the aesthetic appeal of structures but also contributes to energy efficiency by utilizing natural light, thereby reducing the need for artificial lighting.

Composition and Structure

The primary components of pellucid concrete include fine-grained concrete and optical fibers. Typically, the mixture consists of about 95% fine-grained concrete and 5% optical fibers. The optical fibers are embedded throughout the concrete, creating a network that transmits light from one side of the material to the other. This configuration allows for the transmission of light and even shadows, depending on the arrangement and density of the fibers.

Performance Characteristics

Studies have investigated the performance of pellucid concrete in terms of its mechanical properties and light-transmitting capabilities. For instance, research involving the use of plastic optical fibers (POF) with diameters of 2mm placed at 30mm spacing in 150mm concrete cubes examined the compressive strength of the material. The percentages of optical fiber used ranged from 0% to 6.5% of the total weight of the concrete. The findings indicated that while the inclusion of optical fibers enhances light transmission, there is a corresponding impact on the compressive strength of the concrete. Specifically, as the percentage of optical fibers increases, the compressive strength tends to decrease. However, the reduction in strength is within acceptable limits for certain architectural applications where light transmission is prioritized.

CONCLUSION

Compression Test

Compression test is done by applying load on cube in parallel as well as perpendicular direction to the plastic optical fibre) . It was noticed that in parallel loading strength increases continuously while in perpendicular loading strength increases upto 1% of plastic optical fibre then it decreases abruptly. In parallel loading maximum strength change was noted when 1% plastic optical fibre is added. It was also noted that strength obtained was more when load is applied parallel as compared to perpendicular loading.

Flexural Strength Test

In this test the strength is increasing continuously in both cases i.e 0.2mm dia of plastic optical fiber as well as 0.5mm of dia of plastic optical fiber. In each (0.2mm & 0.5mm) plastic optical fiber strength goes on increasing. Here also the max. change in strength was noted on addition of 1% plastic optical fibre to the concrete.

Light Transmission Test

In Light transmission test there will be an increase in the light passing through the block as there is an in increase plastic optical fibre content . The transmission of light through light transmitting block is dependent on diametre of optical fibre used i.e more light passes through 0.5mm dia than 0.2mm dia.

Cost Analysis

The Pellucid concrete has the beautifying properties that in turn attracts the new generation, but increase in the cost of optical fibre will directly affect its use, so cost is increasing with the addition of optical fibre with concrete (Ref. Table 6.9). Eventually to select the optimum percentage of optical fibre, the maximum amount of strength is noticed at 1% to 1.5% and at that percent there is lesser optical fibre consumption that is affordable too, so 1% to 1.5% content of POF should be preferred.

FUTURE SCOPE

- Tests for sensing can be carried out, which will be a revolutionary thing in civil engineering.
- Test for signal transfer for telecommunication can be performed on pellucid concrete.
- Test with different mix design (i.e M15,M25,M30) can be performed.
- Tests with plastic optical fibre more than 2% can be done, for the purpose of more transmission of light although it will add upto the cost but where more light is needed, it can be used.
- Optical fibre sensor can be built-in to check temperature of building.

REFERENCES

1. A.A. Momin, R.B. Kadiranaikar (2014), “Study on Light Transmittance of Concrete Using Optical Fibres and Glass Rods” (IOSR-JMCE) e-ISSN: 2278-1684, PP 67-72.

2. A.B.Sawant, R.V.Jugdar (2014), "Light Transmitting Concrete by using Optical Fibre" International Journal Inventive Engineering and Science Vol.3 Issue 1, PP. 23-28.
3. A.Karandikar, N.Virdhi (2015), "Translucent Concrete: Test of Compressive Strength and Transmittance" International Journal of Engineering Research & Technology Vol. 4 Issue 7, PP. 177-180.
4. A.Losonczi (2001), "Seeing through Concrete by litracon" hungarian-success-stories.com/2013/03/10/seeing-through-concrete
5. B.F.Bashbash, M.Hajrus (2013), "Basics of Light Transmitting Concrete" Global Advanced Research Journal of Engineering Technology and Innovation Vol. 2 Issue 3, PP. 76-83.
6. B.K.Kashiyani, V.Raina, J.Pitroda (2013), "A Study on Transparent Concrete: A Novel Architectural Material to Explore Construction Sector" International Journal of Engineering and Innovative Technology Vol. 2, Issue 8, PP. 83-87.
7. H.M.Sonawane, S.M.Sonawane (2016), "A review on various measurement techniques of Fiber Optical Sensors" International Journal of Engineering Development and Research Vol. 4, Issue 2 PP.1843-1845.
8. J.Shen, Z.Zhou (2013), "Some Progress on Smart Transparent Concrete" Pacific Science Review, Vol. 15, Issue 1, PP. 51-55.
9. Jianping He, Zhi Zhou and Jinping Ou (2011), "Study on Smart Pellucid Concrete Product and Its Performances" The 6th International Workshop on Advanced Smart Materials and Smart Structures Technology ANCRiSST2011 July 25-26,PP. 1-13.
10. L.F.Boswell and B.McKinley (2006), "Use of optical fiber technology to measure structural performance" Challenge Journal of Structural Mechanics Vol. 1, Issue 2, PP. 48–58.

11. M.Mahdikhani, Z.Bayati (2008), "Application and Development of Fibre Optic Sensor in Civil Engineering" The 14th World Conference on Earthquake Engineering October 12-17, 2008, Beijing, PP 1-8.
12. M.N.V.P.Bhushan, D.Johnson, A.B.Pasha (2013), "Optical Fibres in the Modeling of Translucent Concrete Blocks" International Journal of Engineering Research and Application Vol, 3, Issue 3, PP.12-17.
13. M.Sangeetha, V.Nivetha (2015), "An Experimental Investigation on Energy Efficient Lightweight Light Translucent Concrete" International Journal for Scientific Research & Development Vol. 3, Issue 2, PP. 127-130.
14. N.Nagdivei & S.D.Bhole (2013), "To Evaluate Properties of Translucent Concrete/Mortar & their Panels" International Journal of Research in Engineering & Technology Vol. 1, Issue 7, 23-29.
15. P.Gaurao, P.Swapnal (2015), "Light Transmitting Concrete-A New Innovation" International Journal of Engineering Research and General Science Vo. 3, Issue 2, PP. 806-811.
16. P.M.Shanmugavadivu, V.Scinduja (2014), "An Experimental Study On Light Transmitting Concrete" International Journal of Research in Engineering and Technology Vol. 3, Issue 11, PP. 160-163.
17. P.Bishetti, S.D.Ojanahalli, Sohail,Rajiva (2016), "Experimental Study of Translucent Concrete on Compressive Strength" International Journal of Technical Research and Applications Vol.4, Issue 4 PP.120-122.
18. R.Pradheepa, S.Krishnamoorthi (2015), **"**An Experimental Study on Translucent Concrete" International Journal for Scientific Research & Development Vol.3, Issue 03, PP. 174-177.
19. S.Ravivarman, M.Mageswari (2015), "Experimental study of Litracon" Journal of Mechanical and Civil Engineering Vol. 12, Issue 6, PP 07-13.