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Translucent Concrete

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***Abstract*— The skill of building construction arouse for human need for a shelter. Since then the skill has been susceptible to various changes due to outer environment and the man's need. Nowadays the skill has turned into an art in the need for a more elite and modern housing. This is fulfilled by the vast achievements that science have accomplished. In the recent times the possibility to accomplish one of the greatest and toughest part of converting concrete into both an elite and an eco-friendly material is now at our hands as the TRANSLUCENT CONCRETE. This report focuses on various materials that can be used to transfer light in concrete and at the same time to retains its compressive strength.**

***Keywords*— Translucent, acrylic strips, optic fiber, elite, eco-friendly, aesthetics, compressive strength.**

I. INTRODUCTION

A. General

Concrete is a significant component in the construction scenario. The longevity of a structure is directly dependent on the quality and nature of the concrete used, yet concrete can also be used as an architectural element. This report we discuss about the light transmitting property of concrete and a way to use them in green buildings, thus turning concrete into a green element.

This study, particularly aims at using concrete as also an architectural element rather structural and its feasibility of production without use of complicated equipment and methodology.

B. Translucent Concrete

Concrete with the characteristic of transferring light from one end of its face to other is termed as translucent concrete. This type of concrete provides better and easier day lighting, thereby creating ambiences that are better and more naturally lit, at the same time as significantly reducing the expenses of laying and maintenance of the electric lines.

It is made by arranging thousands of optical fiber filaments or acrylic glass strips on either side faces which allows the light to get transferred from one side to the other. Due to the small thickness of these filaments, they combine with the concrete. Compared with a traditional electric lighting system, illuminating the indoors with daylight also creates a more appealing and healthy environment for building occupants. It was a combination of optical fibers and fine concrete, combined in such a way that the material was both internally and externally homogeneous. It was manufactured in blocks and used primarily for decoration

C. Ordinary Portland Cement

Ordinary Portland Cement (OPC) is the most common cement used in general concrete construction when there is no exposure to sulphates in the soil or groundwater. Cement can be defined as the bonding material having cohesive & adhesive properties which makes it capable to unite the different construction materials and form the compacted assembly. Ordinary Portland cement is one of the most widely used type of cement used as a basic ingredient of concrete, mortar, stucco and most non-specialty grout. The name Portland cement was given by Joseph Aspdin in 1824 due to its similarity in color and its quality when it hardens like Portland stone. Portland stone is white grey limestone in island of Portland, Dorset. The OPC was classified into three grades namely 33 grade, 43 grade and 53 grade depending upon the strength of the cement at 28 days when tested.

D. Fine Aggregate

Sand is a naturally occurring granular material composed of finely divided rock and mineral particles. It is defined by size, being finer than gravel and coarser than silt. Sand can also refer to a textural class of soil or soil type; i.e. a soil containing more than 85% sand-sized particles by mass. The composition of sand varies, depending on the local rock sources and conditions, but the most common constituent of sand in inland continental settings and non-tropical coastal settings is silica, usually in the form of quartz.

E. Fly Ash

Fly ash is one of the naturally-occurring products from the coal combustion process and is a material that is nearly the same as volcanic ash. Volcanic ash concrete was used thousands of years ago to produce Roman concrete structures that exist and function today e.g., the Pantheon, Coliseum, and ancient aqueducts. When coal is burned in today's modern electric generating plants, combustion temperatures reach approximately 2800°F. The non-combustible minerals that naturally occur from burning coal form bottom ash and fly ash. Bottom ash is a light-weight aggregate material that falls to the boiler bottom for collection. Fly ash is the material that is carried off with the flue gases, where it is collected and can be stored in silos for testing and beneficial use

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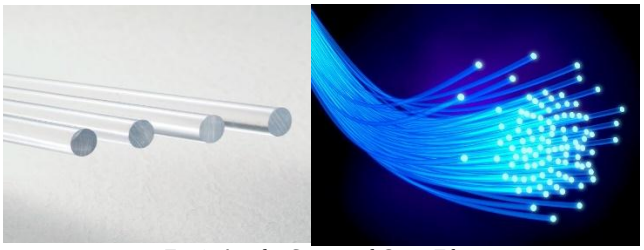

Fig 1: Acrylic Strips and Optic Fibre

F. *Acrylic Glass*

Poly-Methyl Methacrylate (PMMA), also known as acrylic or acrylic glass, is a transparent thermoplastic often used in sheet form as a lightweight or shatter- resistant alternative to glass. The same material can be utilized as a casting resin, in inks and coatings, and has many other uses.

G. *Optical Fiber*

An optical fiber or optical fiber is a flexible, transparent fiber made by drawing glass (silica) or plastic to a diameter slightly thicker than that of a human hair. Optical fibers are used most often as a means to transmit light between the two ends of the fiber

Optical fibers generally work as a hollow cylindrical waveguide which transmits light along its axis, by the principle of total internal reflection the optical fiber strands.

H. *Conplast sp337*

Conplast SP337 is a chloride free high performance water reducing admixture based on specially selected and blended organic polymers. It is supplied as a brown solution which instantly disperses in water. Conplast SP337 disperses the fine particles in the concrete mix, enabling the water content of the concrete to perform more effectively. The improved dispersion of cement particles enhances the efficiency of hydration.

II. LITERATURE REVIEW

A. . *Compressive Strength of Translucent Concrete (2015)*

Salmabanu Luhar et al, The compressive strength of translucent concrete was compared with that of conventional concrete to find out the potential of using translucent concrete for construction of green buildings. Translucent concrete was prepared by embedding plastic optical fibres in concrete.

B. *Study of Translucent Glass Concrete (2016)*

Sisira Sugunan et al, In this paper, experimental studies were conducted in order to analyse the possibilities for recycling waste glass as fine aggregate for concrete. This paper focuses on making a solid building block by replacing fine aggregate with crushed glass waste and also to introduce translucency for aesthetic effect.

C. *An Experimental Study On Light Transmitting Concrete (2014)*

P.M.Shanmugavadivu et al, Light transmitting concrete is one of the fibre reinforced concrete which is used for aesthetic application by incorporating the optical fibres in concrete. When the fibres are arranged in different layers, that increases the load carrying capacity and also the patter can be created to make the concrete decorative.

D. *Optical Fibres in the Modelling of Translucent Concrete Blocks(2013)*

M. N. V. Padma Bhushan et al, Translucent concrete is a concrete based material with light-transmissive properties, obtained due to embedded light optical elements like Optical fibers in it. Light is conducted through the stone from one end to the other. This results into a certain light pattern on the other surface, depending on the fibre structure.

E. *Translucent Concrete (2013)*

Soumyajit Paul et al, Concrete with the characteristic of being translucent will permit a better interaction between the construction and its environment, thereby creating ambiences that are better and more naturally lit. Along with the translucent characteristics, the paper confines its area towards the reinforcement method of this type of concrete such that they can be practically implemented as a load bearing structure.

III. EXPERIMENTAL PROCEEDINGS

1. *Preparation of moulds*

Moulds are prepared based on the size of the Optic Fiber/ Acrylic strips and the pattern preferred. For this experiments special moulds were prepared for the casting of blocks fitted with Acrylic Strips and Optic Fibers.

Fig 2: Mould used for casting of Acrylic strips and Optic Fiber blocks

2. *Casting of Blocks*

The blocks were casted under four mix ratios. They are as mentioned in the table.

Table 1: Details of Mix Ratio

Ratio Name	*Cement:F.A.	**W/C Ratio	Conplast sp337
Mix Ratio 1	1:3	0.25	12ml/kg of cement
Mix Ratio 2	1:4	0.25	12ml/kg of cement
Mix Ratio 3	1:3	0.40	12ml/kg of cement
Mix Ratio 4	1:4	0.40	12ml/kg of cement

From the Mix Ratios mentioned in the above table, The

*In the above table Fine Aggreates consist of 50% of river sand and 50% of Fly Ash.

**The water cement ratio is taken for Cement + Fly Ash

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first two mix ratio, i.e. Mix Ratio 1 & 2 is used to cast conventional and Acrylic Strip concrete. Whereas the other 2 ratios are used for the casting of Optic Fiber cubes.

3. Demoulding

The demoulding process is carried out after 24 hours after the casting process is done. This is done to ensure that the concrete has started to set and take the initial shape.

Fig 3: Demoulded Conventional and Acrylic Strip Blocks

Fig 4: Demoulded Optic Fiber Block

4. Curing

After the demoulding processes the specimens are placed for curing inside the curing tank for 28 days. Water present in the curing tank must have a Ph value less than 6 because the acidic nature it will affect the quality of concrete.

IV. TESTING OF BLOCKS

Varied tests can be performed on concrete to check its strength and quality. For the experimentation purpose of this project thee tests has conducted been on the specimen, they are namely

- Rebound hammer
- Ultra sonic pulse velocity
- Compressive strength

1. Rebound Hammer Test

Principle: The under lying principle of the rebound hammer test is the rebound of an elastic mass which depends on the hardness of the surfaces which the mass strikes againt.

Fig 5: Rebound Hammer Test

Table 2: 28th Day Rebound Hammer Test (Rebound Values)

Ratio Name	Conventional	Acrylic	Optic Fiber
Mix Ratio 1	19.1	18.9	-
Mix Ratio 2	21.6	20.13	-
Mix Ratio 3	-	-	19.33
Mix Ratio 3	-	-	20.48

2. Ultra Sonic Pulse Velocity

Principle: The method consists of measuring the time of travel of an ultrasonic pulse passing through the concrete being tested. Comparatively higher velocity is obtained when concrete quality is good in terms of density, uniformity, homogeneity etc.

Fig 6: Ultra Sonic Pulse Velocity

Table 3: 28th Day Ultra Sonic Pulse Velocity Test (Pulse Velocity mm/µs)

Ratio Name	Conventional	Acrylic	Optic Fiber
Mix Ratio 1	3.34	3.01	-
Mix Ratio 2	3.13	3.14	-
Mix Ratio 3	-	-	3.14
Mix Ratio 3	-	-	3.16

3. Compressive Strength Test

Objective: This test is conducted to find out the actual compressive strength of the cubical block casted.

Fig 7: compression testing

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Table 4: 28th Day Compression Test Results
(Compessive strength N/mm^2)

Ratio Name	Conventional	Acrylic	Optic Fiber
Mix Ratio 1	3.34	3.01	-
Mix Ratio 2	3.13	3.14	-
Mix Ratio 3	-	-	3.14
Mix Ratio 3	-	-	3.16

V. RESULT COMPARISION

1. *Rebound Hammer Test*

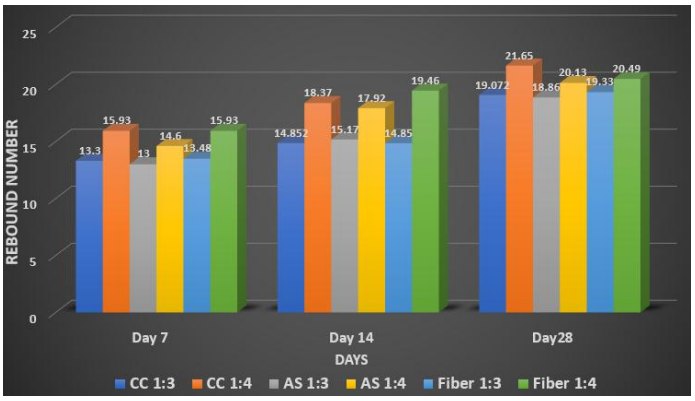

Fig 8: Rebound Value Comparision

The graph indicates the gradual increase of quality of concrete in the due progress of curing. at the end of 28 days the quality of concrete reaches a fairly good level. so we can conclude that the cement mortar concrete exhibits the same properties as that of the normal concrete.

2. *Ultra Sonic Pulse Velocity Test*

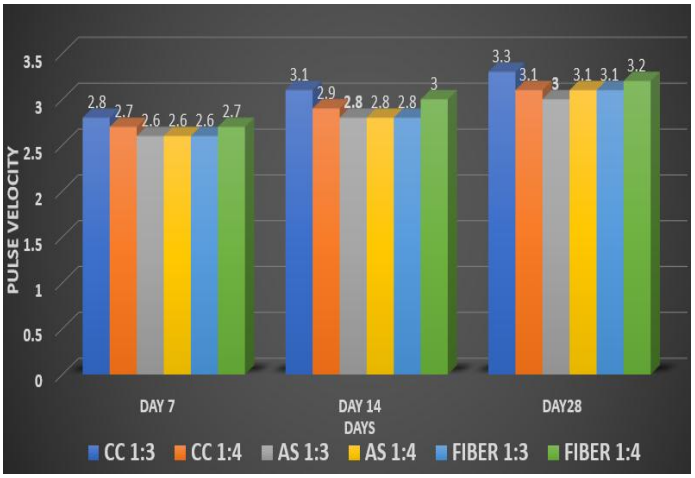

Fig 9: Sonic Pulse Velocity Comparison

The graph indicates the gradual increase of quality of concrete in the due progress of curing. at the end of 28 days the quality of concrete reaches a fairly good level. so we can conclude that the cement mortar concrete exhibits the same properties as that of the normal concrete.

3. *Compression Test*

Fig 10: Compressive Strength Comparision

As the graph indicates there is a gradual increase in strength from 7th day to 28th day. The specimen reaches about 55-60% of the final strength during the 7th day. The average compressive strength of 1:4 mix ratio seems to be better than the 1:3 ratio. So we can conclude that the cement mortar concrete exhibits the same properties as that of the normal concrete.

4. *Light Transmissive Property*

Fig 11: Light Transmission In Acrylic Strips

Fig 12: Light Transmission In Optic Fiber

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VI. CONCLUSION

Till day translucent concrete is fabricated by mixing optic fibers along with cement mixture, this process involves the use of more advanced techniques which leads the method to be more costly and difficult. In order to reduce the cost of and the difficulty of preparation methodology we have used Acrylic glass strips and ordinary 60µm optic fiber instead of the conventionally used optic fiber. According to the findings of the project we can infer that usage of acrylic strips produce better illumination, is also easy to handle than ordinary 60µm optic fiber. Also the use of Acrylic strips also promote the usage of coarse aggregate of size about 10mm which can increase the strength of the concrete by many folds neglecting the deficiency of strength factor in translucent concrete. Thus the project concludes with the fact that the usage of acrylic strips will provide fair illumination, better strength and is comparatively of low cost.

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