International Journal of Innovative Research in Computer Science & Technology (IJIRCST)
ISSN: 2347-5552, Volume-10, Issue-5, September 2022
https://doi.org/10.55524/ijircst.2022.10.5.18
Article ID IRPV1055, Pages 125-132
www.ijircst.org

Experimental Study on the Behavior of Concrete Using Translucent Material

Adil Ahmad[1], and Er Anuj Sachar[2]

[1]M.Tech Scholar, Department of Civil Engineering, RIMT University, Mandigobindgarh, Punjab, India
[2]Assistant Professor, Department of Civil Engineering, RIMT University, Mandigobindgarh, Punjab, India

Correspondence should be addressed to Adil Ahmad; miradil1111@gmail.com

ABSTRACT- Energy efficient and safety of structures have gained worldwide attention in present scenario. Concrete being considered as one of the major backbone of structures can be modified in order to improve its everlasting properties. In this research, the concrete having Plastic optical Fibres are discussed. This study will also discuss about the effect of strength on the concrete once fibres are added in it. This concrete is related to environmentally friendly or "green" energy saving construction since it will save energy by reducing the consumption of electricity and is a promising thing in the field of constructions or civil engineering. In previous studies, mostly fine aggregates where used to make the transparent concrete but in this study coarse aggregates of maximum size 10 mm where also used and also self-compacting admixture SNF is used in this study to eliminate the vibration effect. Through study, it was observed that strength of this concrete is comparable to conventional concrete and also transmitting light through it without any dissipation of energy. The main purpose of this study was to use sunlight as light source without decrementing the strength of concrete.

KEYWORDS- Translucent Concrete, Plastic Optical Fibres, Compressive Strength, Flexural Strength, Light Transmission Test, Conductive Concrete.

I. INTRODUCTION

We are creating with disturbing pace. We are stacking our air with a large number of pounds of CO2 consistently. To counter this CO2, more trees and manor should be finished. According to the evaluations, in US just, to counter the colossal measure of CO2, trees should be planted on 2.15 billion sections of land of land (The aggregate land in US is 2.3 billion sections of land) Shocking isn't it. So simply planting trees is not in the sufficiently least.

Research and studies demonstrate that the developments have huge measure of commitment in dirtying nature around us. As indicated by Green Building Council's investigation of Environmental effect of structures (2007), Buildings in each nation contribute 38.9 percent of the country's aggregate carbon dioxide outflows, (counting 20.8 percent from the private segment and 18.0 percent from the business segment), 39 percent of aggregate vitality utilize, 12 percent of the aggregate water utilization, 71 percent of aggregate powerutilization.

The skirt at which we are bringing our delightful planet Earth in our visually impaired keep running of improvement is greatly basic and requirements a total "green arrangement", which is 'Green Building'.

Green Building alludes to the use of condition neighbourly and asset proficient procedures at each phase of development, appropriate from choice of site and outlining of structure to development, operation took after by keeping up the structure, redesign or even pulverization of the said structure. The attempt is to look for least conceivable effect on condition due the development or improvement we are doing.

The idea of Green Building focuses for the most part on two noteworthy destinations:

- Increasing the productivity with which structures utilize vitality, waterand materials
- Reducing the impact of building effects on human well-being and the earth, through great site determination, better outline, reasonable development strategy, operation, legitimate upkeep, and evacuation around the total life cycle. Become environmentally viable in developments and systems profits us numerous Environmental, Economical and additionally Socialadvantages.

II. REVIEW LITERATURE

Basma F. Bashbash (2013) - This study is all about the strength criteria of the translucent concrete. In this study, different proportions of Plastic Optical Fibre are used and different diameter POF are used. Effect of POF on strength is checked after different time intervals. Being a construction material the translucent concrete should have sustainable strength and should withstand different loads coming onto it. This study is all about that. The study concluded by giving perfect scenario about the effect of Plastic Optical Fibre on strength and hence enhancing its reputation[1].

Zhi Zhou et at (2006) - According to his study, the surface roughness in most of the sections and light transmission performance of translucent concrete materials is completely determined by the internal Plastic Optical Fibre ratio. As per his study this material should be used for exhibition rather than just a construction materials. Plastic Optical Fibre based Transparent concrete could be considered as an art which would be used in museums also[2].

Varsharainaet (2013) - In this study most of the preference was given on energy conservation side or we can say green effect. As we know Modern construction's

and energy consumptions with eco-friendly way is developed in the building aesthetic. The main purpose of using natural light i.e. daylight as a light source is to limit the power utilization of brightening and to utilize the Plastic Optical Fibre(POF) to stands the anxiety going onto the structures and furthermore this translucent concrete as a design reason for good tasteful perspective of the building. This kind of building materials i.e. one using transparent concrete can integrate the concept of green buildings or green energy saving buildings with the usage of self-sensing properties which can help in finding the life of the structure[3].

Jian Ping Heetal (2011) - As per his study of phenomenal properties of light directing and elasto-optic impact of Optical Fiber the Plastic Optical Fiber Volume proportion to Concrete is corresponding to transmission of light and depict the viability of savvy Transparent cement and they gave conclusion that translucent cements has great light controlling property. The measure of the Plastic Optical Fibers has truly impacted the compressive quality of the given cement. The counter penetrability of the translucent cement has likewise been lessened by the Plastic Optical Fiber[4].

M.N.V.Padma Bhushan et al.[2013] investigated Translucent concrete,a concrete- based material with light-transmissive properties obtained through the incorporation of light optical elements such as optical fibres.Light travels from one end of the stone to the other.Depending on the fibre structure,this produces a specific light pattern on the opposite surface.optical fibres transmit light so efficiently that there is almost no light loss as it travels through the fibre[5].

Alejandro Fastag (2011)- Design manufacture of translucent architectural precast panels. Alejandro Fastag achieved a translucent product of embedding the cylinders[6].

III. OBJECTIVE OF THE RESEARCH

To check how the Introduction of Plastic Optical fibre will affect the:

Compressive Strength of the Concrete having Plastic Optical Fibre in it in comparison with normal concrete.

Flexural strength of the Concrete having POF in it in comparison with normal concrete.

To `check for Light Transmission of the concrete in artificial as well as natural light source.

To study how different volume of fibres have effect on compressive as well as flexural strength ofconcrete.

To study how different diameter fibres have effect on compressive as well as flexural strength ofconcrete.

To determine workability of the concrete made after adding admixtures by performing Slump ConeTest.

A. Research Methodology

The main onus of this research is to compare the mechanical properties like compressive strength, and flexural strength of concrete made with the addition of Plastic Optical Fiber's. The basic tests which were carries out and the equipment that were used during this study are discussed in this chapter. Following is the brief idea about the mix and the curing process which was adopted and the test which were conducted on the concrete specimens are discussed below.

B. Fine Aggregates

The Natural Sand of Zone II, with the maximum size of 4.7 mm was used as Fine Aggregates.

C. Sieve Analysis of Fine Aggregates

It is used to know the grading zones which form the basis of serviceability and durability of the concrete. The sieves which are used of sizes for conducting the test are 10mm, 4.75mm, 2.36mm,1.18mm,600u,150u,75u.100 gm material is sieved.

D. Coarse Aggregates

The Natural Coarse aggregates with the maximum size of 10 mm were used.

E. Water

The potable tap water is suitable and can be used in the concrete mix. Water of streams and lakes not rivers and sea's, which contain the marine life, also satisfy the requirements and no necessary sampling of water is required when its coming from these so source's and it should not be used if the water that is coming contains waste, sewage or mine water that is coming from different industrial plants, or can be used once testing is done and tests show positive results. In this study, potable tap water is used for casting concrete specimen.

F. Admixture

The admixture which was used in this mix proportion was SNF. It's a super plasticizer which is composed of Sulpholated Naphthalene Formal Dehyde. The use of admixture increased the workability which in turn decreased the water content. It is used in self-compacting concrete. We used this admixture to lower the water content and also make the concrete flow on its own without requiring any sort of compaction or vibrations.

G. Plastic Optical Fibres (POF)

The Plastic Optical Fibres used in the study were of diameter 0.5 mm and 1.0 mm. The number of fibres to be mixed in the mix are calculated as per the volume of the mould. In this study, we used two volumes of fibres i.e. 0.5% POF and 1% POF by volume of cube mould Number of fibres used in each block are shown in.

Table 1: Plastic Optical Fibres (POF)

1 mm Plastic Optical Fibre (POF)	
% age of POF Used	Number of POF Wires used in 1 Cube
0.5 % POF	144
1.0 % POF	287
0.5 mm Plastic Optical Fibre (POF)	
%age of POF Used	Number of POF Wires used in 1 Cube
0.5 % POF	574
1.0 % POF	1147

H. Mix Proportion

Mix proportion is decided on the basis of Indian Codes i.e. IS 456 and IS 10262. For the study, we used M25 mix along with self-compacting agent. Mix proportion for M25 is taken as per code. The proportions in these mix designs

are shown in Table 2.

Table 2: Mix Proportion

Mix	Cement	Fine Aggregates	Coarse Aggregates	Water/ Cement ratio	Admixture
M30	1	0.75	1.5	.35	.5% by wt. of cement

I. Quantity of Material Used

Quantity of all material is calculated using basic analysis of rates. Weight batching is done in our study. All the quantities are calculated as per codal provision's and then weighed and then mixed inside the mixer. Below are the quantities calculated for one cube of 150 mm x 150 mm x 150 mm:

IV. METHODOLOGY OF EXPERIMENT

A. Preparation of Mould

During the time spent making light transmitting concrete, the initial step included is planning of shape. The shape required for the throwing can be made with various materials which can be of either tin, wood or cardboard. In the shape planning, it is vital to settle the essential measurements of form. The standard least size of the 3D shape as indicated by IS 456-2000 is 150 mm x 150 mm x 150 mm for cement. In the form, markings are made precisely as indicated by the span of the 3D shape so that the cardboard boards can be settled in it. Cardboard boards are utilized which will be useful in making holes and give a smooth surface to the form. We used a standard mould which is mostly used for casting cubes. Below image shows a standard mould used in the study (Fig 1).

Figure 1: Preparation of Mould

B. Procedure of making Translucent Panel

Preparation of the Mould: Make the required size of rectangular mould from Cardboard. Perforations are made and plastic pipes are attached to it per the volume of fibres used.

Different orientations are made in this study so as to check which orientation provides best illumination. Some of the panels made are as under in Fig. 2

Figure 2: Cardboards plastic pipes

Optical Fibre: The optical fibres are cut as per the mould size. In fact, size is kept a bit long then the size of the mould. In our case, we had used a standard mould size 150 mm x 150 mm x 150 mm so the length of each fibre is kept around 250mm so as to compensate any loss or error. Figure showing fibres in size of mould are shown below in Fig 3.

Figure 3: Optical Fibre

Fixing the Fibres: These optical fibres are inserted through those pipes and fixed using paper tape so that we won't lose any fibre while we are pouring concrete. Top of the panel is also fixed with the cardboard panel. Figure showing this all is shown below

Concreting: Pouring the concrete mixture in smaller or thinner layer carefully in mould. The concrete made in mixer is poured slowly onto the mould. The panel should be kept in such a way that when we are pouring concrete it won't affect the fibres else there might be loss of light. Self-compacting agent comes into effect in this very step as we don't require vibrations for compaction of the concrete poured. Below figure shows the concreting process in action.

Removing the Mould: Once the concreting is done our casting part is done. Next step is removal of mould. The mould is kept as such for 24 hours minimum so that the cube is perfectly set. Once it is 31out from the mould is shownbelow in Fig 4.

Figure 4: Removing the Mould

Cutting of the fibres: Once the mould is taken out the excess fibre is cut and the surface is made smooth so that there is no loss of light. This complete our casting part of the translucent concrete. Now our cube is ready and the testing part is to be done.

V. EXPERIMENTAL INVESTIGATION

A. Compressive strength Test

The cubes of size (150 x 150 x 150) mm were prepared for Compressive Strength Testing. The weight of these materials was taken as per the mix proportion i.e. Cement, Fine Aggregates, Water, Coarse Aggregates, were mixed for the uniformity and then the water is added about 50% to mix it thoroughly for some time and then the remaining water is added in short intervals to mix the materials thoroughly. The mix made is then filled in the oiled mould. The specimens were taken out and covered with gunny bags for the prevention against evaporation. Nine isotropic cubes were casted every time. Three were tested after 7 dayscuring.

The specimens were then taken out after 24hours of casting and were put into the water bath for the defined time. Once Curing is done, the specimens were taken out from the water bath and then were kept in the sunlight for 10 – 15 minutes for surface drying. The cubes casted were then tested in the compression testing machine. Shown below in Fig 5.

Figure 5: Compressive strength Test

B. Flexural Strength Test

The cubes of size (150 x 150 x 150) mm were prepared for Compressive Strength Testing. The weight of these materials was taken as per the mix proportion i.e. Cement, Fine Aggregates, Water, Coarse Aggregates, were mixed for the uniformity and then the water is added about 50% to mix it thoroughly for some time and then the remaining water is added in short intervals to mix the materials thoroughly. The mix made is then filled in the oiled mould. The specimens were taken out and covered with gunny bags for the prevention against evaporation. Nine isotropic cubes were casted every time. Three were tested after 7 dayscuring.

The Flexural Strength is calculated by placing the beam under 4-point loading set- up in the compression testing machine as shown in figure given below. Once the loads are applied, pure bending zone with constant bending moment is determined and zero shear in the middle of the span is made.

Also, we can use Compressive strength to find out the flexural strength of the concrete block by simply using the codal provision i.e.Flexural Strength of Concrete = .7 x (sqrt of compressive strength of that block).Fig 6

Figure 6: Flexural Strength Test

C. Light Transmission Test

The Light Transmission test was carried by using an electronic Lux meter. In this test, we simply keep a heap of cubes which we have already made and make an arrangement in such a way that they are kept one over another and side by side forming a small wall. We Place Plastic Optical fibre's parallel to the surface on which it is going to be rested and we cover both the faces of the concrete wallby a ply board so that we can trap the light between them. After that with the help of an electronic lux meter we measure the amount of light passing through Light Transmitting Concrete. Fig 7

Figure 7: Flexural Strength Test

VI. RESULTS

- **Workability:** The workability of the concrete is done by slumpcone
- Test. The slump value of the concrete mix made was found out to be 120 mm. Since we are using self-compacting agents this value is within IS Codal Provisions.
- **Compressive Strength Test:** Below is the table showing the compressive strength of cubes in MPa after curing of 7 days. Every value is obtained after testing of 3 cubes minimum and then taking mean of it.Shown in Table 3 and Fig 8

Table 3: Compressive StrengthTest after 7 days

Compressive Strength after 7-Days				
Optical Fibre % Used	Strength in N/mm^2			
	Load pplied Parallel to Plastic optical fibre		Load Applied Perpendicular to plastic optical fibre	
Normal Concrete				
Dia. Of POF	.5 mm	1 mm	.5 mm	.1 mm
0.5% POF	17.41	17.89	17.32	17.50
1.0% POF	18.90	19.72	18.48	19.15

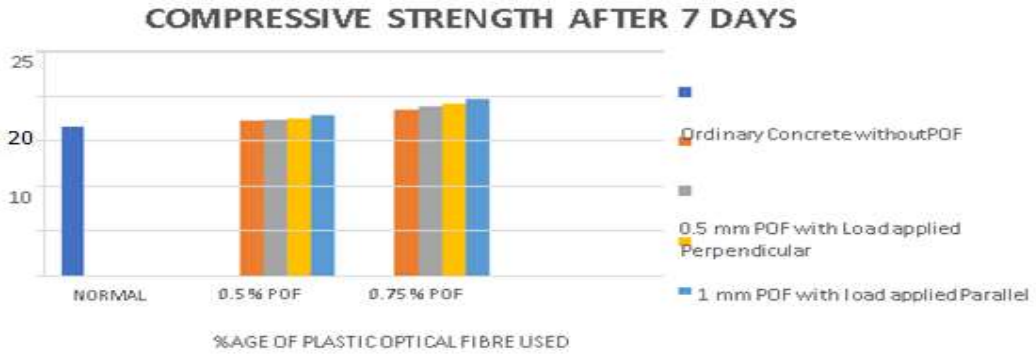

Figure 8: Compressive Strength Test after 7days

Compressive Strength after 14-Days shown in table 4 and Fig 9.

Table 4: Compressive Strength Test after 14days

CompressiveStrengthafter14-Days				
Plastic Optical Fibre % Used	**StrengthinN/mm^2**			
	Load Applied Parallel to Plastic optical fibre		Load Applied Perpendicular to lastic optical fibre	
Normal Concrete	**21.68**			
Dia. Of POF	.5 mm	1 mm	.5 mm	.1 mm
0.5%POF	22.52	22.94	22.27	22.69
1.0%POF	23.97	24.59	23.48	24.17

Compressive Strength test after 28-Days shownin Table 5 and Fig. 10

Table 5: Compressive Strength test after 28

Compressive Strength after 28-Days				
Plastic Optical Fibre % Used	StrengthinN/mm^2			
	Load Applied Parallel to Plastic Optical fibre		Load Applied Perpendicular to Plastic Optical fibre	
Normal Concrete	24.5			
Dia.OfPOF	.5 mm	1 mm	.5 mm	.1 mm
0.5%POF	25.51	25.84	25.37	25.60
1.0%POF	26.90	27.62	26.40	27.10

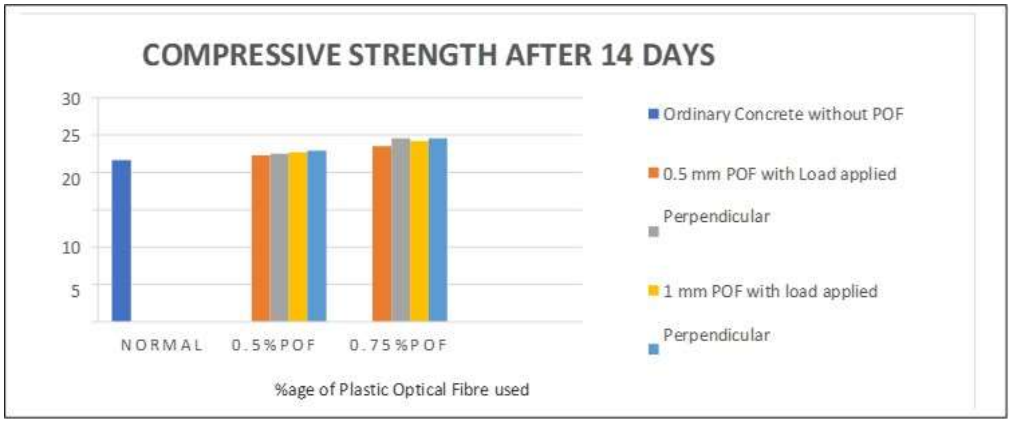

Figure 10: Compressive Strength test after28-Days

1) Flexural Strength Test

Below is the table showing the flexural strength of cubes in MPa after curing of 7, 14 and 28 days. Every value is obtained after testing of 3 cubes minimum and then taking mean of it.Shownin Table 6 and Fig 11,12,13

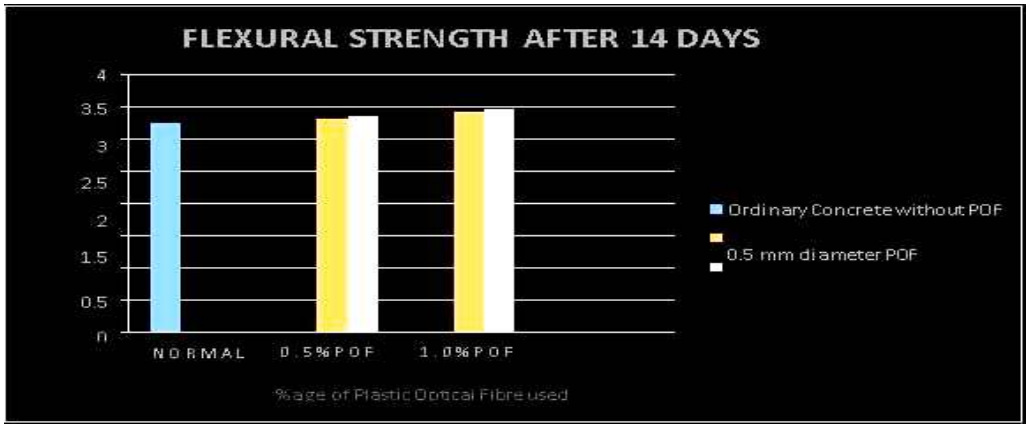

Figure 11: Flexural Strength in 7 days

2) Light Transmission Test

Table 6: Flexural Strength Test

Plastic Optical Fibre% Used	**FlexuralStrengthinN/mm2**					
	7-Days		14-Days		28-Days	
Normal Concrete	2.85		3.25		3.46	
Diameter of Plastic optical Fibre	0.5	1.0	0.5	1.0	0.5	1.0
0.5% POF	2.92	2.96	3.32	3.35	3.53	3.55
1.0% POF	3.04	3.10	3.42	3.47	3.63	3.67

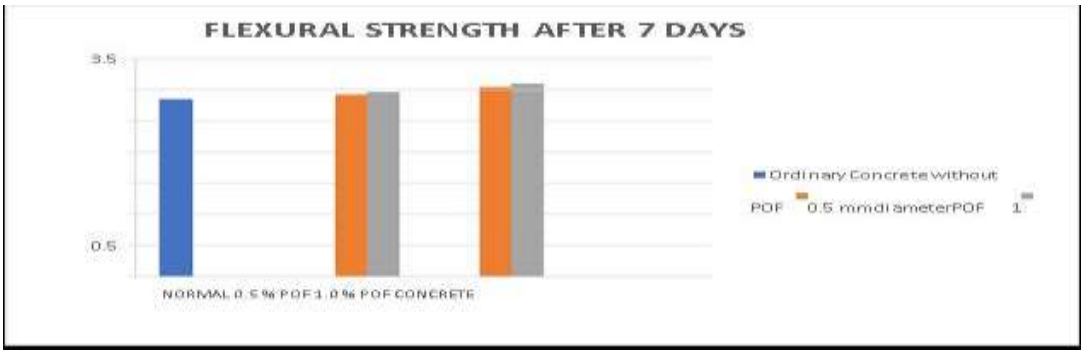

Figure 12: Flexural Strength in 14 days days

Every value is obtained after taking a minimum of 3 readings of lux meter and then taking mean of it. The light transmission value as measured using an electronic Lux meter having different %age of fibre used and different diameter of fibre used showing in table 7 and Fig 14,15

Table 7: Light Transmission Test

% age of fibre used	Artificial Source of Light		Natural Source of Light	
	.5 mm	1 mm	.5 mm	1 mm
0.5 % POF	80	110	134	265
1.0 % POF	180	254	300	411

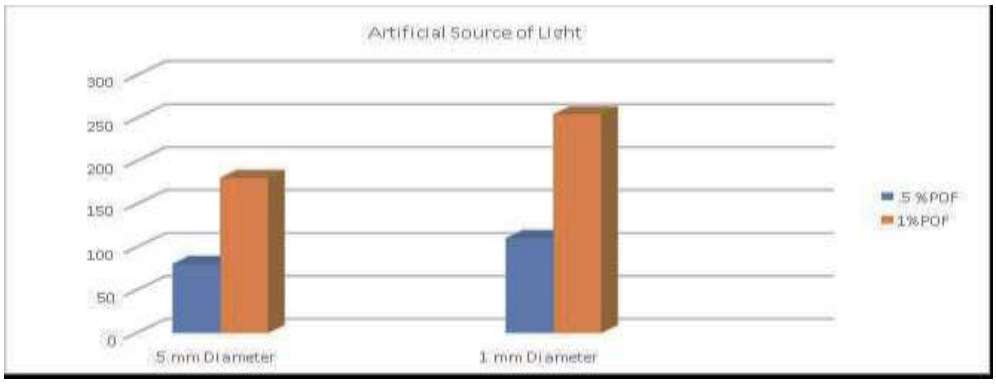

Figure 13: Flexural Strength in 28 days

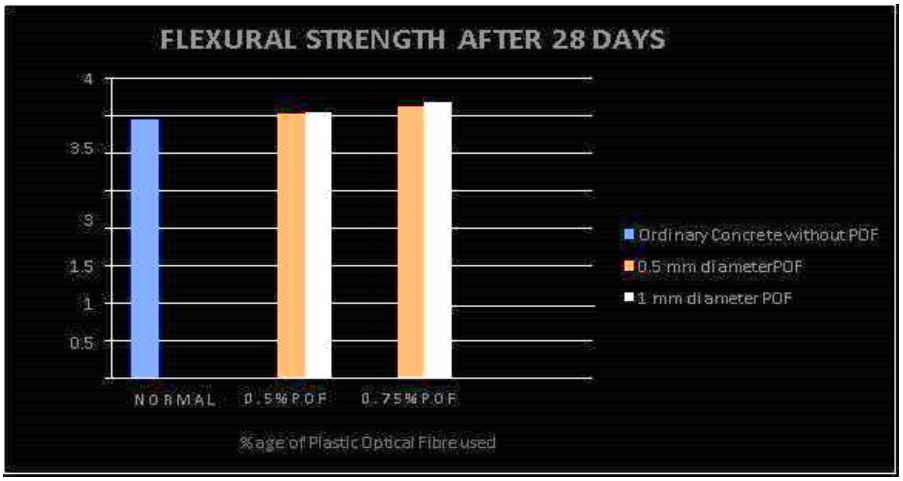

Figure 14: Artificial source of light

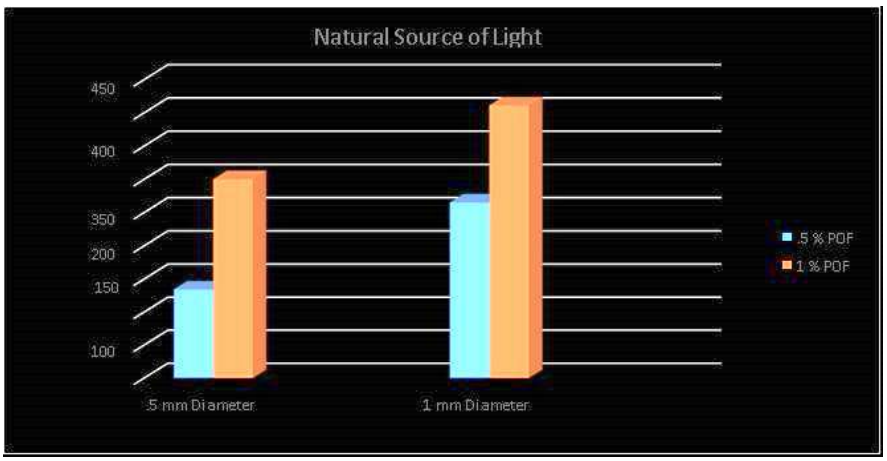

Figure 15: Natural source of light

VII. CONCLUSION AND FUTURE SCOPE

Translucent solid blocks can be utilized as a part of numerous ways and executed into many structures and be exceptionally favourable. However, the main disadvantage would be its high cost. That doesn't prevent high class draftsmen from utilizing it. It's an incredible indication of fascination and creative advancement. Any structure with a little clue of translucent cement will undoubtedly make heads turn and make them remain in amazement. Aside from the excellence perspectives, there's likewise this security and supervision. Substantial houses, with huge security dividers are frequently low on security. That is the reason they are for the most part fitted with shocked fencing Green structures would get a simple accreditation under light investment funds with this. Huge and tall office structures can share the lighting when the roofs are translucent. Vitality investment funds and in addition warm protection straightforward adds to
the rundown of its astounding properties. Straightforward cement is what's to come. It is the keen method for advancing and using light, a savvy method for living. This ornamental cement
can be utilized as a part of inside outline of structures as boards in pieces, dividers and soforth.

In this study, we found out that the strength of transparent concrete is comparable with nominal concrete in fact it's much better then nominal concrete. With increase of fibres the transmission of light is more but that doesn't mean that more fibres can be used since it will lower the strength as studied from earlier researches. Our aim in this research was to successfully use coarse aggregate in this transparent concrete which was not earlier used in any researches which we did. Our research was quite satisfactory since all our results were quite good. Our cubes were having better strength then nominal cubes. Apart from cost factor all things are in favour of this environmental friendly concrete. Since this project is still very young therefore with every passing research and application the cost factor will also drop and then this concrete type will be future of construction or civil works. It will be the smart way of optimizing and utilizing light, a smart way ofliving.

A lot of further study can be done in this research. Varying diameter of fibres with varying volume of fibres can be used and their effect can be studied. Numerous admixtures and materials can be used and their effect can be studied. This is still a very new study with huge potential. This type of concrete is the future since it saves energy and has huge potential which can only be achieved by further researches.

REFERENCES

[1] Basma F. Bashbash. (2013). ―Basics of light Transmitting Concrete, pp 079- 083,(2013)

[2] Zhi Zhou1,2, Ge Ou, Ying Hang, Genda Chen, Jinping Ou., Research and Development of PlasticOptical Fiber Based Smart Transparent Concrete, Published on Proc. of SPIE Vol. 7293 72930F-1

[3] Varsharaina, ―A Study on Pellucid Concrete: A Novel Architectural Material to Explore Construction Sector, International Journal of Engineering and Innovative Technology, volume 2, issue 8, pp83-87,(2013)

[4] Jianping He, Zhi Zhou and Jinping Ou, Study on Smart Transparent Concrete Product and Its Performances, proceedings of the 6th International Workshop on Advanced Smart Materials and Smart Structures Technology ANCRiSST2011 July 25-26, 2011, Dalian,China

[5] M.N.V. Padma Bhushan, D. Johnson, Md. Afzal Basheer Pasha ―Optical Fibers in the Modeling of Translucent Concrete Blocks ISSN: 2248-9622 May-June 2013

[6] Alejandro Fastag (2011),- Design and manufacture oftranslucent architectural precast anels. SymposiumPRAGUE,1053-1056