



Light Transmitting Concrete using Eco Friendly materials (Waste materials)

A Jayaraman¹, S M Gowtham², N Praveen³, V Hariharan⁴, M Refak Afrith⁵,

¹Assistant Professor, Department of Civil Engineering Bannari Amman Institute of Technology, Sathamangalam-638401, India

^{2, 3, 4, 5} UG Students, Department of Civil Engineering Bannari Amman Institute of Technology, Sathamangalam-638401, India

Abstract : Concrete is a composite material composed of fine and coarse aggregate bonded together with fluid cement that hardens over time. Now days mostly the construction researchers have been trying to improve the quality and reduced dead weight of the structure and enhance its performance. In this current situation there is a demand in natural sand so engineers are using manufactured sand. The aim of our project is to reduce the dead weight of the structure as well increase the strength of the concrete. So we developed light weight aggregate and sand by using waste plastic and glass materials. We developed a concrete by using crushed glass bottles and melted plastic which is considered as light weight concrete. Glass is an ideal material for recycling use of recycled glass helps in energy saving. This indicate that glass can be effectively used as a fine aggregate replacement without substantial change in strength and also we used aluminum metal powder for reducing the member weight by introduced air in concrete. For the innovative and aesthetic purpose we made the concrete to glow using plastic optical fiber which acts as a transmitting agent which also called as translucent concrete in which the optical fiber is inserted in parallel way. We used epoxy to harden the optical fiber (0.75mm) and M20 grade concrete.

Keywords : Fine glass-waste plastic aggregates-epoxy-optical fiber ,aluminum metal powder.

I Introduction

Now days power generation and saving the current is major world wide problems. the power generation department meet the lot of problems everyday due to some natural resoures and industrial. power consumption is more day by day increased due to automobile industry, machine manufacturing of industry, software field and increased population , same time we loss the natural sourses. in this project report discuss about the power generation from the concrete panel in structures. light transmitting concrete developed by

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plastic optical fibre. This paper contributes to the determination of new alternatives for sustainable construction around the world. LTC can help to reduce power consumption in buildings by allowing natural light to shine into the building interior through external walls by **Abdelmajeed Altomatea et al (2016)** Recently nowadays light transmitting concrete is developed by the light weight and same times developed the strength of the concrete. In India and worldwide, variety of waste is generated in different forms, shape and texture. These industrial wastes mostly possess threat to the environment and the society living nearby. Various researches has been done on this waste material to either degrade or to utilize it in some or the other way by **Jayaraman et al (2014)** , the main aim of the project is to develop the strength of the concrete and light transmission of concrete by reinforcing optical fibers. In this report conclusion conventional concrete and translucent concrete strength is more or less same. We can develop modern architecture structures using reinforcing optical fibers. Light weight concrete is developed by light weight aggregate. The light weight aggregate is made from the recycled plastic (high density polyethylene), the compressive strength , split tensile strength and flexural strength is obtained from the (0% to 40%) recycling of plastic aggregate by **Anju Ramesan et al (2015)**. Nowadays waste materials mostly develop the light weight materials in construction field example for plastic aggregate made from burning of plastic materials, glass sand made from the crushing of waste glass materials. The partially replacement of glass powder by cement. The main aim of the project is to developed the green environment and the concept of green building. The focus of this investigation to evaluate the possibility of using waste glass powders in concrete .using the partially replacement of waste glass powder in cement, we can reduced the density of concrete & emission of carbon-di oxide by **Sudharsan N et al (2019)**. light weight concrete is develop by light weight aggregate and foaming agent, light weight aggregate recently develop waste materials such as plastic materials. **Azad Khajuria et al (2019)** he reported that the compressive strength, tensile , flexural strength and light weight concrete is developed by partially replacement of plastic waste aggregate. various percentage of plastic aggregate used in concrete such as 1% 2.5% ,5% 10% .the optimum compressive strength, tensile strength and flexural obtained at 2.5% of partially replacement of plastic aggregate and workability also increased by plastic aggregate. we can reduce the land pollution by recycling of plastic aggregate. **J.Premalatha et al (2019)** she reported that the partially replacement of glass powder by river sand. The main aim of the project is to developed the compressive strength, tensile strength , flexural strength and water absorption in various grade of concrete and replacing in various percentage of glass powder. The compressive strength, split tensile strength and flexural strength gradually increase upto 30% addition of waste glass powder and for 40% and 50% replacements the strength values are comparable with that of the control specimens. Highly reduced chloride content in concrete by waste glass powder. The chloride penetration test is done by RCPT. In this paper mainly focused develop light transmitting concrete developed by light weight plastic aggregate, glass sand and optical fibres glass.

II Aim of the Product

- The main purpose of this light transmitting concrete panel is of saving energy using natural light and making it as a green building material.
- Due to shortage in coarse aggregate and fine aggregate in the present situation so we replaced with waste glass bottles and waste plastics which is found abundantly in the ground.
- The main objective of the project to reduce the member weight and light transmitting of concrete by eco friendly waste materials and optical fiber.
- We product the light weight concrete elements and light transmitting concrete for marketing purpose.

III Materials and Investigation

3.1. Cement:

Ordinary Portland cement of 53 grade available in the local market is used in the investigation. the cement used has been tested for various properties as per IS: 12269-1987 having high specific gravity of 3.0. The properties of cement given in Table.1.

Table 1 Properties of OPC Cement

Physical properties of cement	
Initial setting time(minutes)	53 mins
Final setting time(minutes)	257 mins
Standard consistency	31.0%
Specific gravity	3.15
Fineness of cement	10%
Chemical properties of cement	
S	20 -21
A	5.3 -5.6
F	4.4 -4.8
C	62 -63
M	0.5 -0.7
S	2.4 -2.8
Loss on ignition(LOI)	1.5 -2.5

3. 2. Glass sand (fine aggregate)

In our investigation we have used the waste glass bottle which is thrown in the ground. We collected all the waste glass bottles from the various places and crushed the bottles using compressive machine and impact testing machine in our lab. After crushing all the bottles we got fine particles of glass powder where we used sieve of 2.56 microns to get finer particles as like fine aggregate.

Glass aggregate can replace part or all of the sand and gravel in concrete, for effects that range from colorful terrazzo, to granite- or marble-like finishes, to concrete that reflects light like a mirror. Glass aggregate can even be used to produce concrete that literally glows. The properties of glass sand given in Table 2 and Figure1.

Table 2 Physical and Chemical Properties of glass sand

S NO	Physical and Chemical Properties of glass sand	Glass % mass
1	SiO ₂	71.35
2	Al ₂ O ₃	1.02
3	Fe ₂ O ₃	8.74
4	CaO	3.55
5	MgO	0.25
6	So ₃	0.37
7	K ₂ O	11.76
8	Na ₂ O ₅	-
9	TiO ₂	0.05
10	P ₂ O ₅	0.01
11	Loss on ignition	147

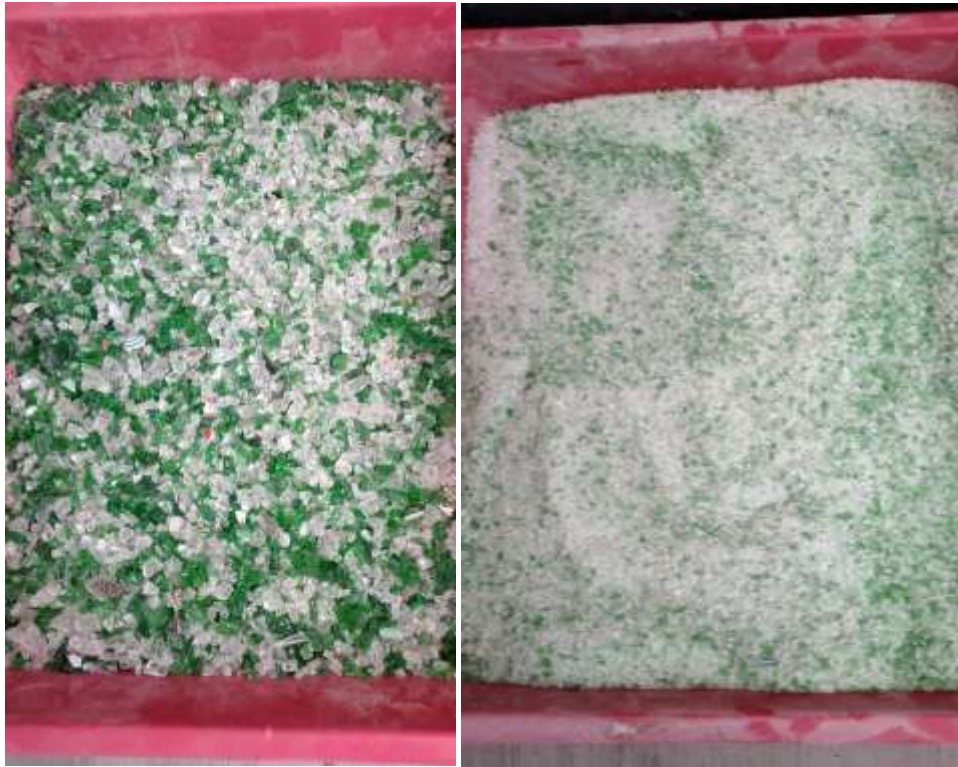


Figure 1 Glass sand

3.3 Plastic aggregate:

The coarse aggregate is the strongest and porous component of the concrete. Presence of coarse aggregate reduces the drying shrinkage and other dimensional changes occurring on the account of movement of moisture. In our investigation we had used the aggregate passing through 20mm IS-sieve and retaining on 12.5mm sieve. In replace we melted plastic bottles and made like coarse aggregate (20mm). Whereas the plastic coarse aggregate can lower the concrete slab weight. So in our project we used plastic aggregate. The physical and chemical properties of plastic aggregate given in Table 3 and Figure. 2 .

Table 3 Physical and Chemical Properties of Plastic Aggregate

S NO	Physical and Chemical Properties of Plastic Aggregate	values
1	Crushing value	0.83
2	Saturated surface dry basis (SSD)	0.87
3	Specific gravity (g / m^3)	2.18
4	24 hours water absorption %	0.05
5	Fineness modulus	5.38
6	Maximum size of aggregate	20
7	Bulk density (kg/m^3)	1510



Figure 2 Plastic Aggregate

Characteristics plastic aggregate:

- Plastics can be used to replace some of the aggregates in a concrete mixture. This contributes to reducing the unit weight of the concrete. This is useful in applications requiring nonbearing lightweight concrete, such as concrete panels used in facades.
- The use of plastics in the mix lowers the density, compressive strength and tensile strength of concrete.
- The effect of water-cement ratio of strength development is not prominent in the case of plastic concrete. It is because of the fact that the plastic aggregates reduce the bond strength of concrete. Therefore, the failure of concrete occurs due to failure of bond between the cement paste and plastic aggregates.

3.4 Plastic optical fiber

Plastic optical fiber (POF) or polymer is an optical fiber that it made out of polymer. Similar to glass optical fiber POF transmit light (for illumination or data) through the core of the fiber. Its chief advantage over the glass product, other aspect being equal, is its robustness under bending and stretching. Optical fiber used in the telecommunications is governed by European standards EN60793-2011.size of the fiber 0.75mm The physical and chemical properties of plastic aggregate given in Table 4 and Figure.3.

Table 4 Physical and chemical properties of optical fibre

S No	Basic properties	Values
1	Core material	PMMA
2	Diameter (mm)	(0.5 – 3) mm
3	Core refraction index	1.49
4	Cladding refraction index	1.42
5	Numerical aperture	0.44
6	Acceptance angle in degree	52.2
7	Storage temperature (°C)	-20 to 70
8	Specific gravity (g /cm ³)	1.19
9	Wavelength (nm)	400 t0 780
10	Limit of bending radius	8 x fibre diameter

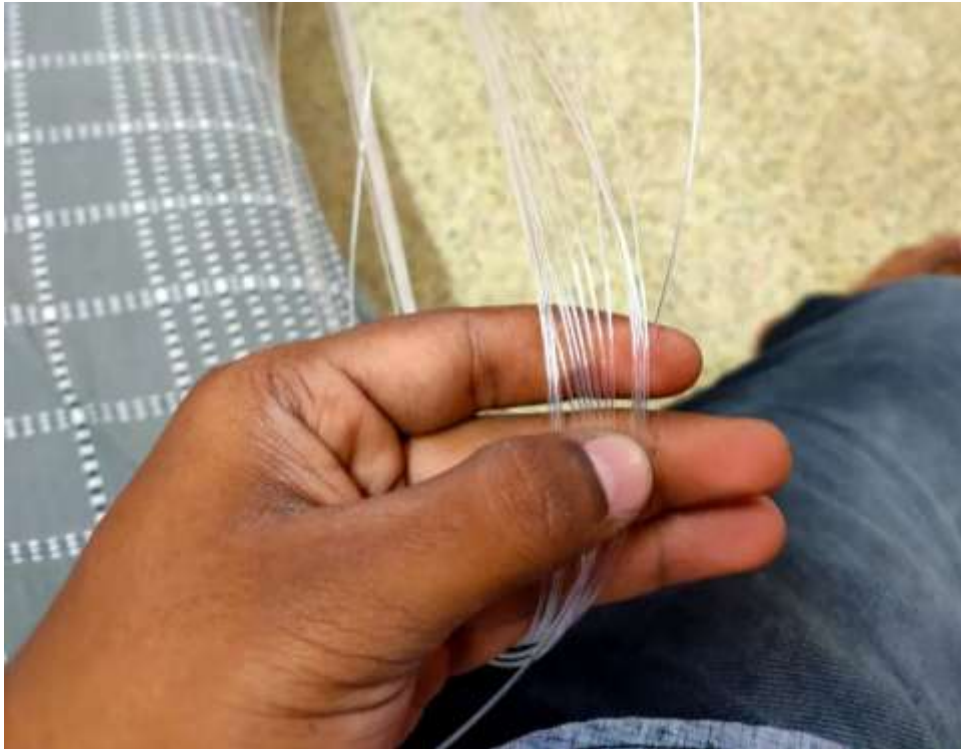


Figure 3 Plastic optical fibre

IV. Experimental Procedure

The mix ratio is prepared for M25 grade concrete for both conventional concrete and Bottom ash & lateritic Sand mix concrete. The Cube size of (150 x 150 x 150) mm Specimen is prepared for compressive strength. The cylinder of height 30 cm and 15 cm diameter is prepared for tensile strength. The specimens are tested for 7 days, 14 days and 28 days with each proportion of waste glass sand , waste plastic materials coarse aggregate and optical fiber mix. Totally there are 18 cubes and 18 cylinders are casted. The panel size of (0.5 x 0.5 x 0.1) m is used for light transmitting concrete panel board. All the specimens are demoulded after 24 hours, and curing is done in water for 7 days, 14 days and 28 days.

IV Result and Discussion

5.1. Compressive strength of concrete.

The test is carried out conforming to IS 516 -1959 to obtain compressive strength of concrete at the 7days, 14 days and 28 days. The cubes are tested using 1400 tonne capacity HELICO compressive testing machine (CTM).The results are presented in Figure.4 and Table 5.

The 7, 14 and 28 days compressive strength of waste material concrete (waste material glass sand + waste materials plastic aggregate) is 13.65 %, 10.53% and of 5.09 % of compressive strength is reduced when compared to the conventional concrete.

5.2. Tensile strength of concrete

The test is carried out conforming to IS 516 -1959 to obtain tensile strength of concrete at the 3 days,7 days, 14 days and 28 days. The cylinders are tested using 1400 tonne capacity HELICO compressive testing machine. The results are presented in Figure.5 and Table 6.

The 7, 14 and 28 days tensile strength of waste material concrete (waste material glass sand + waste materials plastic aggregate) is 15.068 %, 19.50% and of 8.09 % of tensile strength is reduced when compared to the conventional concrete.

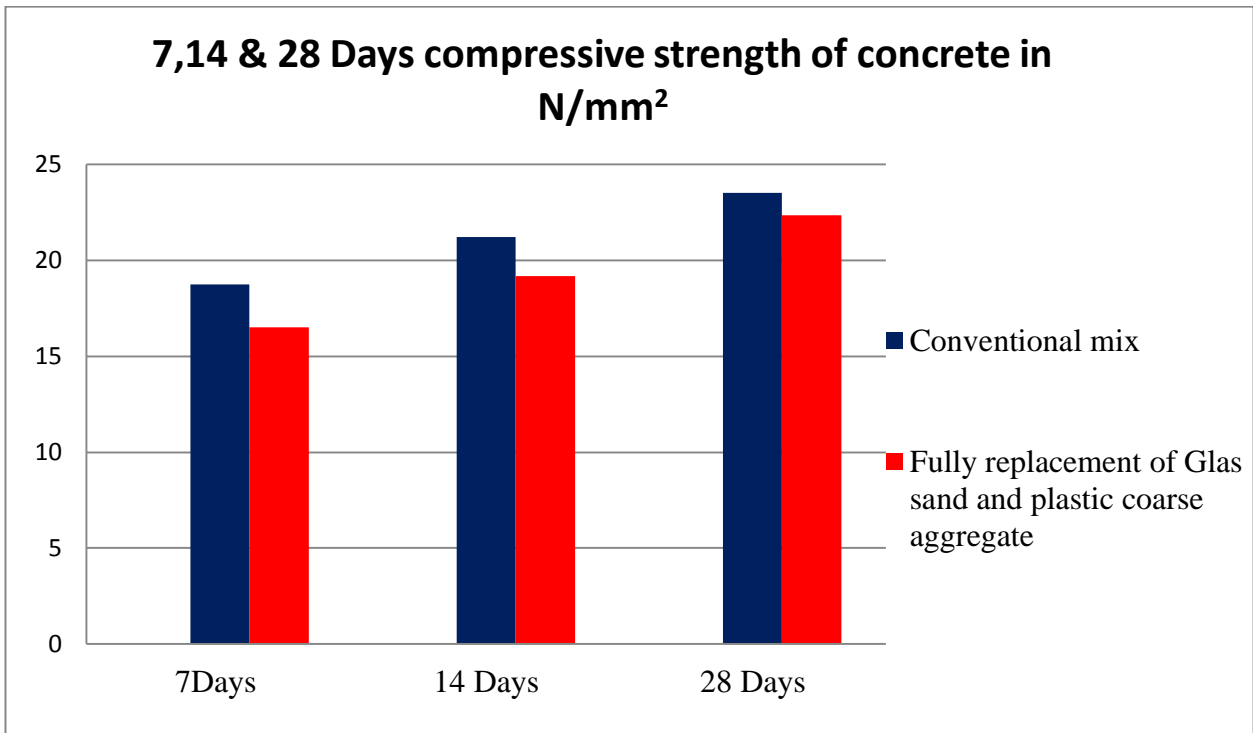


Figure 4 Compressive strength of concrete in N/ mm²

Table 5 Compressive strength of concrete

S.No	Type of mix	7Days Strength N /mm ²	14 Days Strength N /mm ²	28 Days Strength N/mm ²
1	Conventional mix	18.75	21.20	23.50
2	Fully replacement of glass sand and plastic coarse aggregate	16.52	19.18	22.36

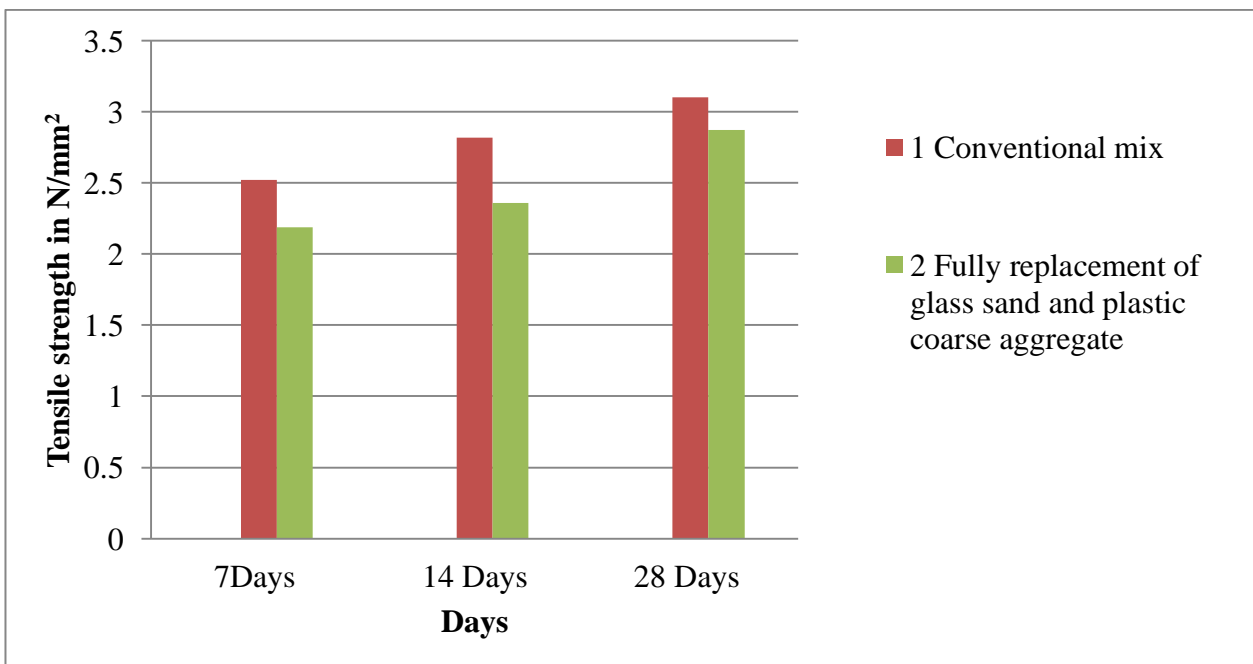


Figure 5 Tensile strength of concrete in N/ mm²

Table 6 Tensile strength of concrete

S.No	Type of mix	7Days Strength N /mm ²	14 Days Strength N /mm ²	28 Days Strength N/mm ²
1	Conventional mix	2.52	2.82	3.1
2	Fully replacement of glass sand and plastic coarse aggregate	2.19	2.36	2.87

5.3 Preparation of Light transmitting concrete panel

5.3.1 Preparing of glass fine aggregate:

Waste glass bottles collect from various processes and as a first step we crushed with compressive test machine and sieved with 2.36 IS sieve and in the impact machine impacted to get finer particles sieved with 1.36 IS sieve as shown in Figure.6.

5.3.2 Making of plastic aggregate:

Waste plastic bottles collected from the thrown field and chemical treatment has been done to clean the bottle. For melting purpose we used microwave oven and gas stone to make irregular shape jelly (20mm). The plastic bottles has melted with more than 200 degree Celsius whereas to get hard, rough surface and irregular shape as shown in Figure.7.

5.3.3 Inserting of optical fibre

Optical fiber has placed vertically over the card board sheet. This is set ready for casting as shown in Figure.8.

5.3.4 Mixing and casting of light transmitting concrete board:

Thus the mixing and casting done m25 mix , with the mixture of cement , glass powder , plastic aggregate and water. The light weight and light transmitting concrete board as shown in figure.9.



Figure 6 Preparing of glass fine aggregate

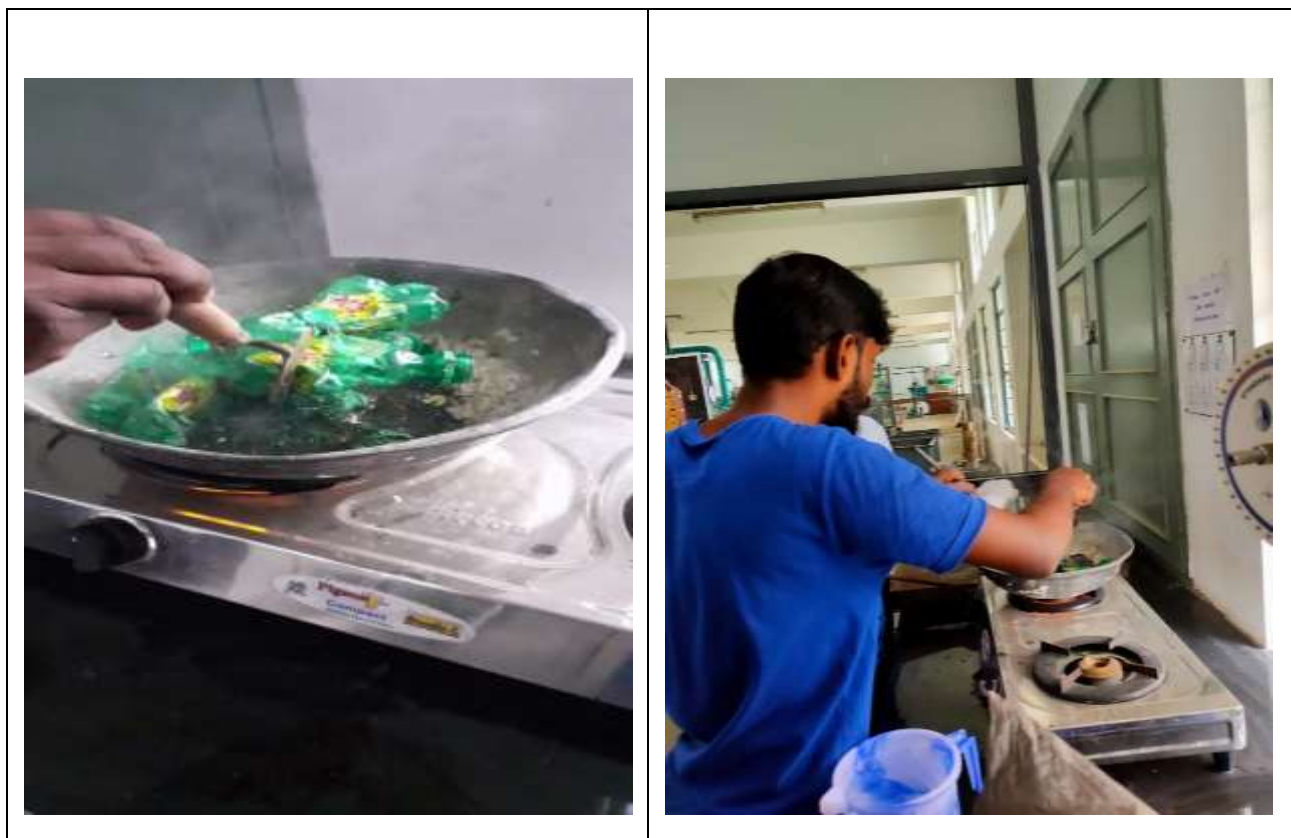


Figure 7 Making of plastic aggregate



Figure 8 Inserting of Optical Fibre

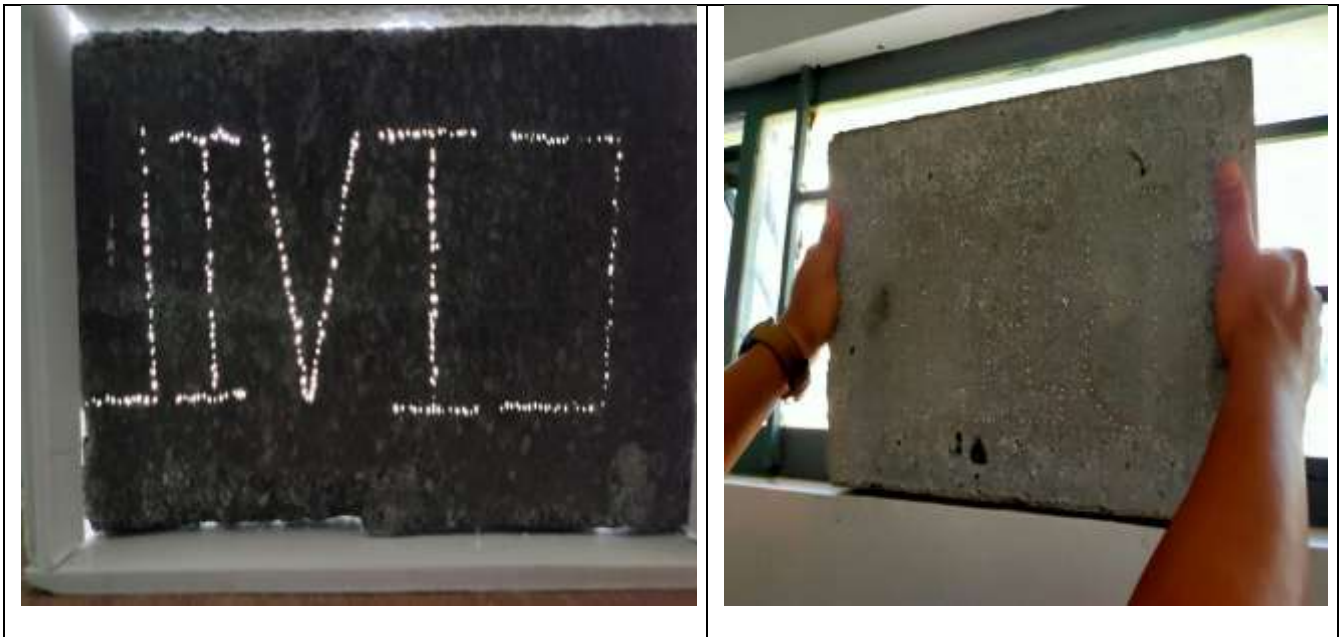


Figure 9 Light weight and light transmitting concrete board

5.3.5 Advantages of Light transmitting concrete panel

- Translucent concrete inserts on front doors of homes, allowing the resident to see when there is a person standing outside.
- Translucent concrete walls on restaurants, clubs, and other establishments to reveal how many patrons are inside.
- Ceilings of any large office building or commercial structure incorporating translucent concrete would reduce lighting costs during daylight hours.
- Sidewalks poured with translucent concrete could be made with lighting underneath, creating lit walkways which would enhance safety, and also encourage foot travel where previously avoided at night.
- The use of translucent concrete in an outer wall of an indoor stairwell would provide illumination in a power outage, resulting in enhanced safety.

5.3.6 Disadvantages of Light transmitting concrete panel

- It is precision material and the correct procedure need to be followed.
- It is extremely important to ensure the integrity of optic strands if they break within the product property would almost be neglected.
- Costing of this material is difficult as the techniques are just start to develop.

VI Conclusion

1. Recycling of waste scrap glass materials and waste plastic materials
2. To reduced all types of pollution such as marine pollution, water pollution, land Pollution, etc.....
3. The full replacement of waste scrap glass sand instead of river sand and waste materials plastic aggregate instead of coarse aggregate.
4. The waste materials concrete, compressive strength concrete is more or less is the same compare to the conventional concrete specimen.
5. Lane markers in roadways could incorporate various colors in the translucent concrete, allowing for dynamic adjustments when required by traffic fluctuations.
6. Subways using this material could be illuminated in daylight.

7. Speed bumps in parking lots and driveways could be illuminated from below, making them more visible and therefore more effective.

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