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Low Cost Translucent Concrete

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ABSTRACT

Translucent concrete aims at providing on energy concrete based light emitting concrete blocks. This project is forwarded with an idea of inducting of optical fibers in the concrete blocks or walls. So that light on pass from one side to another without hindering the privacy of occupants.

They after to taking few steps into the project, we have introduced GGBS(Ground Granulated Blast Furnence Slag) with partially replacement of cement, so that we can achieve higher strength parameters at low cost. Different percentage variations of GGBS are studied in the project, so that we can get the optimum percentage at reasonable strength parameters.

This project mainly enlightens the scope of low cost building blocks which could transmit light efficiently.

Keywords: ***Fibers, Translucent, GGBS***

INTRODUCTION

Concrete, that traditionally solid, substantial building material, is getting a makeover. Engineers have now developed concrete mixtures that are capable of transmitting light. By switching the ingredients of traditional concrete with transparent ones, or embedding fiber optics, translucent concrete has become a reality. “Light Transmitting concrete also knows as translucent concrete”. It is the brightest building material development in recent years. It is one of the newest, most functional and revolutionary element in green construction material. In this paper the manufacturing uses and future scope of transparent concrete is widely given. However, this innovative new material, while still partially in the development stages, is beginning to be used in a variety of applications in architecture, and promises vast opportunities in the future.

Optical Fiber Elements

Core - The thin glass center of the fiber where the light travels.

Cladding - The outer optical material surrounding the core that reflects the light back into the core. To confinethe reflection in the core, the refractive index of the core must be greater than that of the cladding.

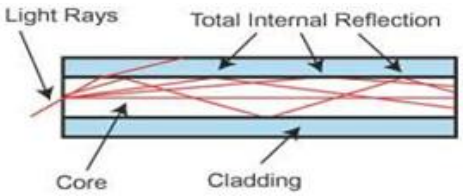

Fig :1 OPTICAL FIBER ELEMNTS

Coating - Plastic coating that protects the fiber from damage and moisture.Our solution used the same principle. For our translucent concrete panel, we needed a core material such as acrylic that will transmit light continuously into the inside of the

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building, a white cladding layer that reflects the light back into the core and concrete as the protective coating.

Light Reflected in Concrete Panel

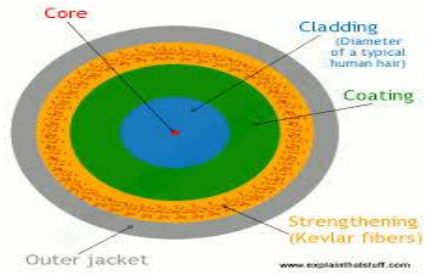

Fig :2 LIGHT REFLECTION IN CONCRETE PANEL

With this idea, we tried with acrylic cylinders of different diameters to evaluate its reflection when casted into different mixes using white cement and white aggregates and sand. With those results we found a diameter that could reflect enough light using our standard 10cm thick panel cast into our typical concrete mix.

Fig 3 (a) LIGHT TRANSMISSION OF OPTICAL FIBERS

An OPTICAL FIBRE is a flexible, transparent fibre made of glass (silica) or plastic, slightly thicker than a human hair. It functions as a waveguide or light pipe, to transmit light between the two ends of the fibre.

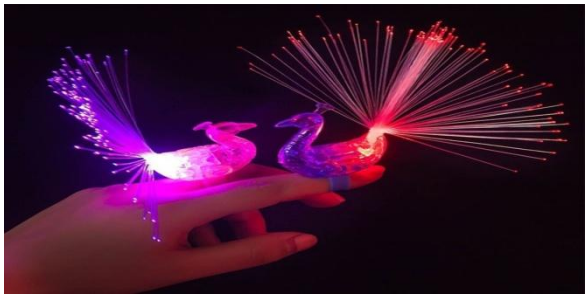

Fig 3 (b) LIGHT TRANSMISSION OF OPTICAL FIBERS

1.2.2 GLASS

Architectural glass is glass that is used as a building material. It is most typically used as transparent glazing material in the building envelope, including windows in the external walls. When used in buildings, glass is often of a safety type, which include reinforced, toughened and laminated glasses.

1.2.3 REUSED PLASTIC

Recycling plastics is helping to save energy and landfill space. Recycled plastics are used in new building and construction applications every day.

Recycled plastics can be blended with virgin plastic (plastic that has not been processed before) to reduce cost without sacrificing performance. Such recycled plastics are used to make polymeric timbers for use in everything from picnic tables to fences, thus helping to save trees.

1.3 GROUND GRANULATED BLAST-FURNACE SLAG (GGBS):

The chemical composition of a slag varies considerably depending on the composition of the raw materials in the iron production process. Silicate and aluminate impurities from the ore and coke are combined in the blast furnace with a flux which lowers the viscosity of the slag. In the case of pig iron production the flux consists mostly of a mixture of limestone and forsterite or in some cases dolomite. In the blast furnace the slag floats on top of the iron and is decanted for separation.

The main components of blast furnace slag are CaO (30-50%), SiO_2 (28-38%), Al_2O_3 (8-24%), and MgO (1-18%). In general increasing the CaO content of the slag results in raised slag basicity and an increase in compressive strength. The MgO and Al_2O_3 content show the same trend up to respectively 10-12% and 14%, beyond which no further improvement can be obtained. Several compositional ratios or so-called hydraulic indices have been used to correlate slag composition with

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TRANSLUCENT MEMBERS

Thanks to new features this material presents innovative technical solutions, semi-natural and ecological, for the traditional construction problems allowing a wide area of applications in construction, architecture, decoration and even furniture. Some of the possible applications for this new material are spread over several areas creating new possibilities to various products such as:

1. Translucent concrete blocks suitable for floors, pavements and load-bearing walls.
2. Facades, interior wall cladding and dividing walls based on thin panels.
3. Partitions wall and it can be used where the sunlight does not reach properly.
4. In furniture for the decorative and aesthetic purpose.
5. Light fixtures.
6. Light sidewalks at night.
7. Increasing visibility in dark subway stations.
8. Lighting indoor fire escapes in the event of a power failure.
9. Illuminating speed bumps on roadways at night.

ADVANTAGES AND DISADVANTAGES

The main advantage of these products is that on large scale objects the texture is still visible - while the texture of finer translucent concrete becomes indistinct at distance.

- When a solid wall is imbued with the ability to transmit light, it means that a home can use fewer lights in their house during daylight hours.
- It has very good architectural properties for giving good aesthetical view to the building.
- Where light is not able to come properly at that place translucent concrete can be used.
- Energy saving can be done by utilization of translucent concrete in building.
- Totally environment friendly because of its light transmitting characteristics, so energy consumption can be reduced.
- The main disadvantage is these concrete is very costly because of the optical fibers.
- Casting of translucent concrete block is difficult for the labour so special skilled person is required.

OBJECTIVEOF INVESTIGATION

OBJECTIVES:

The specific objectives of the present investigation are:

To study the effect of GGBS in the place of cement on initial and finial setting times of cement using potable water.

To study the compressive strength test for the proposed mix ingredients.

To simulate the adverse natural light emotion through construction.

STUDIED PARAMETERS:

1. M Grade of cement ratio used = M 1:2
2. W/C ratio = 0.48
3. Replacement materials = GGBS
4. Total no of specimens = 48

EXPERIMENTAL INVESTIGATIONOF MATERIALS

4.4 OPTICAL FIBER:

It is an optical fiber which is made out of plastic.PMMA(acrylic)is the core material and fluorinated polymers are the cladding materials. In large diameter fiber,96% of its cross section is the core that allows the transmission of light. It similar to the traditional glass fiber, POF transmit light threw the inner core of the fiber.

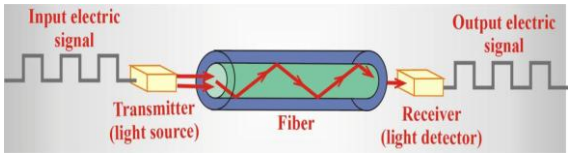

Fig 14: Light Transmission of Optical Fiber.

Here we are conducted the Numerical aperature of Optical fiber and we calculated the light transmitting of an optical fiber ,Light transmitting of an optical fiber is =100 - $(\frac{A1-A2}{A1}) \times 100$ Where, A1- Light transmitting without sampleA2 – light transmitting with sample

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4.5 GGBS:

The ggbs will be adding the partially replacement of cement. And the some tests will be conducted on the ggbs.

The specific gravity of ggbs is determined by correlating the rise of cement and kerosene levels in specific gravity bottle. Since, the cement on mixing with the water hardens so it is mixed with kerosene and the corresponding rise in bottle for specific gravity determination is found.

Specific gravity of cement =3.44 and
Fineness modulus =3.66

EXPERIMENTAL METHODOLOGY

5.1 MIX DESIGN:

The Cement mortar has been designed for M Grade concrete using ISI method. The design procedure is presented in Appendix – I. The mix obtained is 1:2 with water-cement ratio of 0.48 and total mixed proportions.

5.2MIXING OF PROPORTIONS:

For this investigation we have prepared test specimens namely cubes. Totally 48 no's of specimens were cast and tested by considering different % replacements of GGBS at 0%,30%& 50% for cement.

Fig 17: Weighing Of Different Sives of Fine Aggregagte

Fig 18: MIXING OF PROPORTIONS

Fig 19: MAKING OF WODDEN MOULDS FOR OPTICAL FIBER CUBES.

Fig 20: ARRANGEMENT OF FIBERS

Fig 21: ARRANGING OF GLASS PLATES

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Fig 23:CASTING OF CUBES WITH REPLACEMENT OF GGBS

Fig 24:CURING OF CUBE

Fig 25:CURING OF TRANSULCENT CONCRETE CUBES

TESTS AND RESULTS

COMPRESSIVE STRENGTH TEST:

Fig 26: TESTING OF CUBE CONSISTS OF GGBS

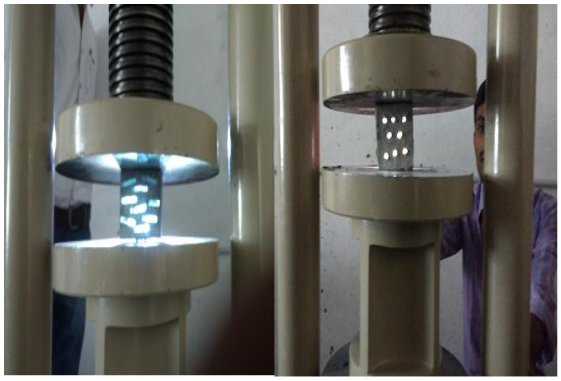
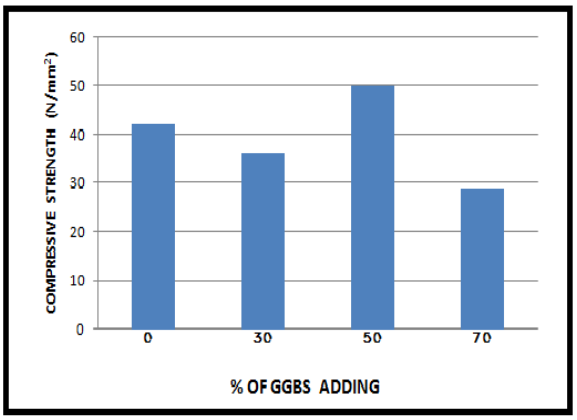


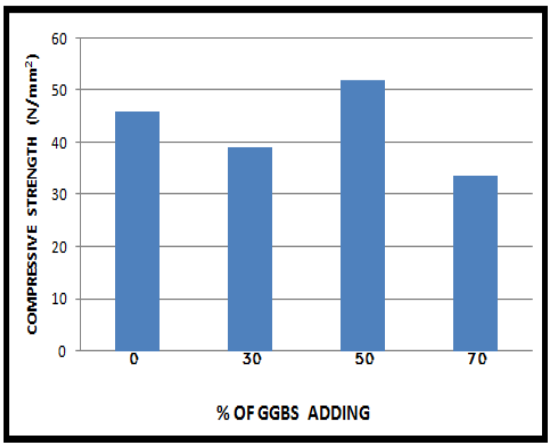
Fig 27:VIEW OF TRANSLUCENT CUBES IN COMPRESSIVE TEST

COMPRESSIVE STRENGTH TEST FOR 7 DAYS:



GRAPH 1: COMPRESSIVE STRENGTH OF CUBE AT 7 DAYS

COMPRESSIVE STRENGTH TEST FOR 14 DAYS:



GRAPH2: COMPRESSIVE STRENGTH OF CUBE AT 14 DAYS

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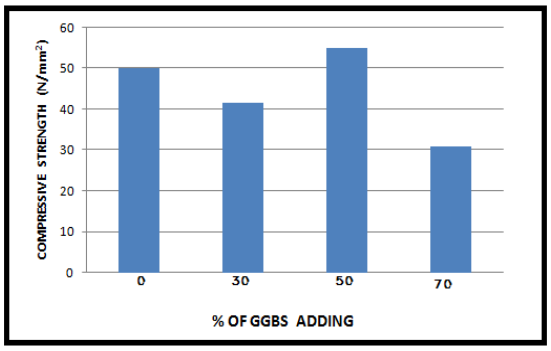
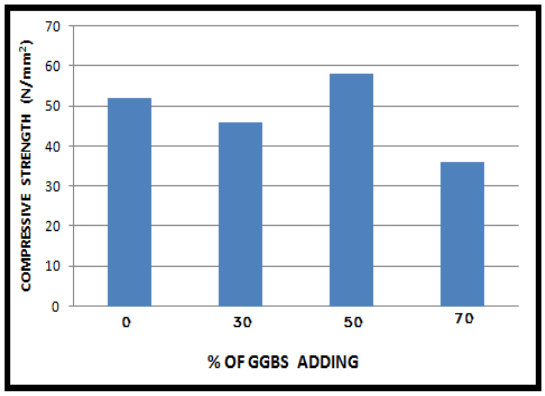
COMPRESSIVE STRENGTH TEST FOR 21 DAYS :



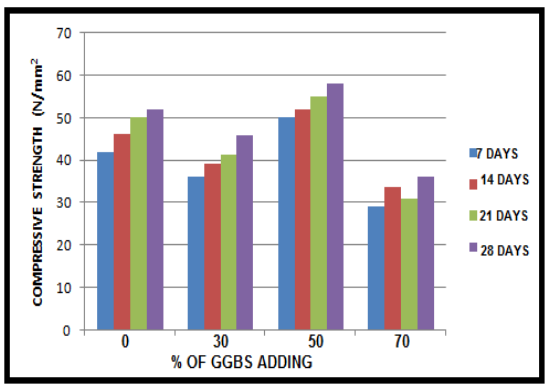
GRAPH3: COMPRESSIVE STRENGTH OF CUBE AT 21 DAYS

COMPRESSIVE STRENGTH TEST FOR 28 DAYS :



GRAPH4 :COMPRESSIVE STRENGTH OF CUBE AT 28 DAY

COMPRESSIVE STRENGTH VARIATION FOR 7,14,21,28 DAYS



GRAPH 5: COMPRESSIVE STRENGTH VARIATION FOR 7,14,21,28 DAYS

6.2 CONTINUITY TESTER:

Fiber Optical Continuity Tester:

Fiber continuity tester is also called fiber optical continuity checker .It is the simplest visual test of a optical cable link.

To function properly ,a optical cable link must be "continuous" ,meaning no breakage ,Either within the fiber cable are in the fiber connectors, should exist. The simplest and least expensive way to check is to inject some visual light into one fiber end and check the light coming out from the other end.

To perform the task ,two types of fiber testers are available ;a fiber optic continuity testers are a laser visuals fault locator.

Understanding the features of a fiber continuity tester

Fiber mode compatibility :

Some fiber continuity testers only support multy mode fibers while the other support both single mode fibers and multy mode fibers .So it's best to check the spec sheet from manufactures to choose the type you need .

b) Fiber Connectors Supported:

Most fiber continuity testers have adapters available for testing 2.5mm ferrule connectors such as ST,SC and FC,1.25mm ferrule connectors such as LC,MU and special types such as SMA connectors .

c)Fiber distance :

Most fiber continuity testers have enough light power to support 2km on multimode fibers.

Light Transmittance Test:

The light transmittance ability of the specimen is tested by an electrical circuit setup with an LDR. The light transmittance threw the sample can be measuring the current corresponding to the light which can be measured by the LDR. From the circuit setup ,we are taking two reading from ammeter , one with out sample(A1),and one with sample (A2).The source

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of light used is taken as 40W incandescent bulb ,a resistance of 100Ω is applied in the circuit setup and uniform DC voltage of 10W is kept between the circuits.

Fig 29: Light Transmission Test Instrument

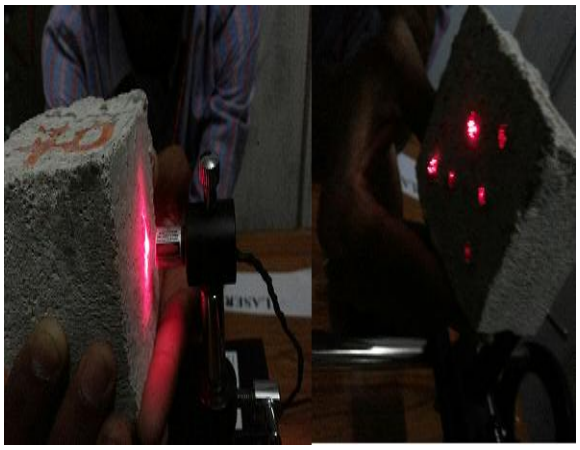

FIG 30: EXPERIMENTAL WORK OF THE CUBE IN CONTINUITY TESTER:

6.3 DISCUSSION OF TEST RESULTS

In the chapter the results of the two test results conducted on the effect of % replacements of GGBS at 0%, 25% & 50% for CEMENT, and for 7, 14, 21 28days of curing

The following tests are –

1. Compressive Strength Test – on CUBES
2. CONTINUITY TESTER:

COMPRESSIVE STRENGTH TEST

If we observed in compressive strength of tables (5,6,7,8) gradually increase of strength is obtained, at the same time presences of GGBS gives thermal cooling to the construction.

6.3.2 CONTINUITY TESTER:

In continuity test , the transmittion of light is more efficient and very good to the construction, taking of light through nature and emitting the light with out heat in to construction.

CONCLUSIONS:

From the limited experiment investigation done is presented study, the following conclusions can be drawn.

Based on the experimental investigation it has been concluded that, up to 50% partially replacement of GGBS with cement get good results in compression strength of 7,14,21 and 28 days.

- After that increase of GGBS get failure of strength
- Using of different types of translucent concrete materials, using of reused plastic is economically less, but as a compressive strength three materials have equal results, because presence of partially replacement of ggbs.

Generally, One cement motar cube cost 11 rupees.If we take translucent concrete cube,

FUTURE RECOMMENDATIONS ENVIRONMENTAL IMPACT

When a solid wall is imbued with the ability to transmit light, it means that a home can use fewer lights in their house during daylight hours. Since the insulating capacity of the wall is unchanged, the result is a net energy gain.

A GLOWING FUTURE

Several years ago, the material was featured in the “Liquid Stone” exhibit at the National Building Museum, and started opening peoples’ eyes to all kinds of possibilities. While the material has distinct architectural and interior design appeal, some of the companies involved in light-transmitting concrete production envision using the distinct looks and unique abilities of this concrete for practical applications. Although translucent concrete has been used primarily

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as an interior decoration, its creators have "visions of cities that glow from within, and buildings whose windows need not be flat, rectangular panes, but can be arbitrary regions of transparency within flowing, curving walls". It can at the same time be building material and light source, can separate and connect, can be wall or floor, ambient lighting or eye-catcher.

Translucent concrete isalso a great insulating material that protectsagainst outdoor extreme temperatures while also letting in daylight. This makes it an excellent compromise for buildings in harsh climates, where it can shut out heat or cold without shutting the building off from daylight. It can be used to illuminate underground buildings and structures, such as subway stations & arranging of translucent concrete in zero energy buildings.

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MODEL

FIG 33 : PREPARING OF MODEL

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