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Use of E-Waste in Translucent Cement Bricks

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Abstract - *Modifying Conventional Cement Bricks by Using E-Waste To make if more Useful in Decorative purposes. This research paper explores the advantages of using translucent bricks and examines the scope of using this as a substitute for jalli system. The function of a translucent brick has been analyzed by measuring features like temperature, intensity of light and safety. The research also probes for a cost effective way to construct translucent bricks in the Indian market by using alternative raw materials. Use of recycled optical fibers from e-waste and use of traditional mud have been deeply considered as alternative materials. The research aimed towards producing a detailed report regarding the same using standard brick tests in a lab. Until now, concrete structures alone were considered as structural members, but in the recent years this idea has been undergoing a massive change with concrete being used for aesthetic considerations too. The research concludes by identifying a combination of high grade concrete with optical filaments that can be used as an add-on material for the beautification of the buildings by making it light emitting.*

Key Words: **Illumination system, E-waste, Optical fiber, Optical cable, Modification, C4X Bricks.**

1. INTRODUCTION

We hunt for a solution to minimize energy by technological innovations, there exists a perfectly viable solution to save energy from illumination and thermal comfort, which also uses recycled e-waste as a major constituent. This innovation exists in the domain of construction with the use of translucent brick, or light transmitting brick, but yet remains to be deeply discovered in its use.

Living up to its name, the translucent brick is on the verge of being transparent. When light is permitted to pass through translucent brick walls, objects on the other side of the separation are seen as vague silhouettes. This could completely revolutionize the illumination requirements of any structure in which it is used. Daylight entry can be maximized without removing separations, and the amount of luminaires can be reduced tremendously. The face of a brick could now be changed from an aesthetically unappealing solid to a semi-transparent, energy efficient element of construction. Giving an ambient lighting with modifiable shadow pattern could make it an elegant choice for any interiors. The translucent brick can also be used as perimeter walls serving the dual purpose of maintaining security and privacy as well as adequate vision.

This translucent property or the light passage property attributed to this modified brick is gained by the addition of light optical elements to the mix. Usually optical fibers are used for the purpose. The importance of using optical fibers can be extended to the fact that they being one of the most used means of data transmission and medical solutions, it could present itself as a potential future waste due to its use in large quantities. Leveled equations, graphics, and tables are not prescribed, although the various table text styles are provided.

Another remarkable advantage of the Translucent brick is that it also acts as an insulating material that can prove to be useful in extreme climatic conditions. It can conserve the heat present inside the building thereby reducing the energy required for heating purposes in cold conditions. It can also act as a barrier that prevents the cooler inner temperature to be lost to the outside heat in case of hot conditions. This makes it a perfect material for buildings in extreme climates that need to be protected from harsh climatic contexts without blocking the building off completely from daylight. Probably the only drawback of transparent brick today is it being too expensive. Even with the cost disadvantage, the material is still being preferred and used by several architects. This is due to the iconic translucent factor.

Translucent brick is therefore a product derived from a combination of applied science, architecture and engineering, thus giving us the most as an efficient energy saver. With this, walls, ceilings and flooring cease to be separating elements or simple surfaces, rather they become energy savers. It is easily the smartest way of optimizing and utilizing light energy in today's world. Therefore, this is a material of tomorrow and holds an immense deal of potential for research and subsequent future developments and innovations.

1.1 E-Waste In India

The development in the field of science and technology during 18th century was a turning point in life style of humans, termed as industrial revolution. The impact of advancement in technology brought many changes in the economy and ecology of our system. This era was followed by the development of communication system during 20th century which in turn completely re-organized the structural system of our economy, education, industry and health.

Undoubtedly these marvelous advancements and inventions improved the quality of our life. Meanwhile it has also led to a manifold of problems including the production of hazardous waste and other wastes from electronic goods. These wastes pose threats to both humans and the environment. The lack of proper waste management system is a threat to life and environment.

Just like hazardous waste, e-waste is also a prime concern to our society due to its uncontrolled accumulation and non-scientific treatment leading to huge environmental and health issues. The advancement in technology has given a facelift in our life style, work and communication, bringing the country a stable economic background. The updated technology and globalization resulted in large production of electronic goods which has ultimately resulted in the heavy and uncontrolled usage of these goods. The people have taken to heart the concept of "use and throw" as these goods have become easily affordable to a majority of the population. These new products are a part of our life, providing us comfort, safety and faster availability of information, while at the same time leads to unrestricted resource utilization and alarming flow of waste due to outdated equipment.

1.2 Objectives

a. To study and develop a new material and various applications in the construction field, architecture, decoration and even in furniture industry.
b. To lower the usage of artificial lightning which can finally result into minimizing the usage of electricity.

1.3 Methodology

Preliminary tests were conducted on the normal conventional concrete materials as per IS standards & specifications for its physical & engineering properties, cubes were casted in the standard metallic moulds & vibrated to obtain the required sample size of specimen. The moulds were cleaned initially and oiled on all the sides before concrete sample is poured in to it. Thoroughly mixed concrete is poured into the moulds in three equal layers and compacted using vibrating table for a small period of 5 minutes. The excess concrete is removed out of the mould using trowel and the top surface is finished with smooth surface.

2. CONCRETE MIX DESIGN

The samples are made using cement and varying optical fiber composition in a standard testing mould of 15cm x 15cm x 15cm under lab conditions. A standard ration of 1:2 for the mixture is fixed for the test. The optical fiber is cut into small filaments of 15.2cm from the large spool.

Materials

There are two basic materials used for making transparent concrete, one is from construction field and another from sensing field. First, concrete is one of the most important civil engineering materials with the advantages of rich raw materials, low cost and simple production process and Second the optical fibre has good light guiding property which can be arrange to transmit the light and the sun light transmit according to pre- design road without light-heat, light-electrical or photochemical process, and photo elastic effect which can be used to study the stress distribution of structures. Combining the advantages of the concrete and optical fibre, developing a novel functional material called transparent concrete has an important value in the application of construction and sensing.

The Mix

The quantity of cement, fine aggregate and water required to prepare a concrete mix of proportion 1:x by weight with water cement ratio "k" for casting 3 cubes 15cm x 15cm x 15cm is calculated. The materials are collected and kept ready. The measured quantity of cement and fine aggregate is mixed dry until the mixture is thoroughly blended and is uniform in color. The water is added and the entire batch is mixed until concrete appears to be homogeneous and has thedesired consistency. Desired quantity of optical filaments of size 15.2cm is weighed and kept aside.

Sr no	Material	Specification
1.	Cement	53 grade
2.	Coarse aggragate	Less than 10mm
3 .	Fine aggragate	Passing through 2.36mm sieve
4.	Concrete	M20 grade
5.	Oprtical fiber	2% - 4%

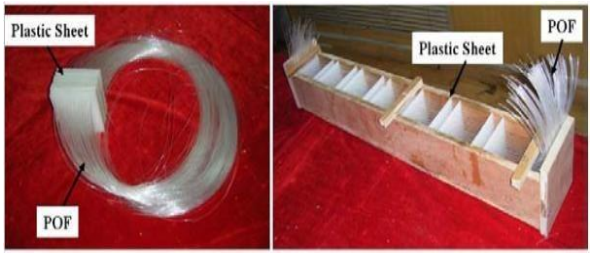
3. PROCEDURE

The cast iron :cubes of size 15cm x 15cm x 15cm is assembled and a layer of oil is applied in the inner surface (to help in de-moulding). The prepared mixture of cement and sand is poured as the first layer and leveled with the measured amount of optical fiber placed on top of the mortar as another layer. The process is continued and the cube is filled. The mixture is left to set for 32 hours and is then demoulded and left for curing. The cubes are cured for 28 days and finally the surface of the cubes are finished using a sandpaper.

Weighing of cement and sand

CALCULATION OF THE QUANTITY OF INGREDIENTS

Sr no	Properties of Cement	Value obtained
1.	Fineness of cement as retained	3%
2.	Grade of Cement	53
3 .	Specific Gravity	3.15
4.	Initial Setting time	30min



Optical Fiber & Wooden Mould

Properties of Transparent Concrete Specimens	Translucent Concrete
Form	Prefabrication
Ingredients	96%concrete, 4% optical fiber
Density	2100-2400 kg/m^2
Block size	600 x 300mm
Thickness	25-500mm
Colour	White, Grey or Black
Fiber distribution	Organic
Finished	Polished
Compressive strength	50 N/mm^2
Bending Tensile Strength	7 N/mm^2

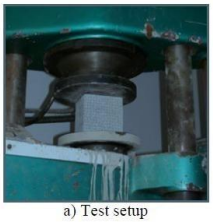
Mix proportion = 1:2

Total volume of the test cube = 15 x 15 x 15 x 0.93 (safe ratio)= 3144cm3

4. TESTING OF SPECIMENTS

Thermal Performance Test The amount of heat absorbed and transmitted by the brick is a key factor for its performance in cost effective energy utilization. Therefore, the thermal properties of the specimens are tested under normal temperature. The main source of heat is considered to be emitted from the specimens that are placed under direct sun light on a raised platform. The temperature on the surfaces are measured using an infrared thermometer. The thermometer is calibrated using a glass of ice. The outer temperature and the inner temperature is measured in a time interval of 1 hour from 7am to 7pm.

Calibration of thermometer

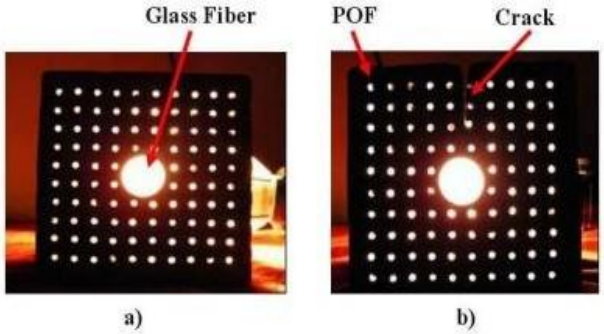


a) Test setup

b) Damage mode

Light Reflection Test

The amount of light absorbed and transmitted by the brick determines the efficiency of the bricks. Hence the properties of the specimens are tested under normal temperature on a sunny day, considering sun as the main source of light. A plywood box is made to measure the efficiency of the specimens by checking the intensity of reflected light through different bricks with varying fiber density using a lux meter.



Properties of Translucent Concrete

Following are the important properties of translucent concrete that makes it advantageous over ordinary concrete.

Durability Property of Smart Transparent Concrete

Civil engineering structures always suffer from external environmental effects, such as fatigue, corrosion and wind load and so on, in long-term service. Mechanical property and anti-corrosion property of building material at adverse environments are two key facts for the durability of in-service structures, which directly impact the safety of structures

Impermeability Property of Smart Transparent Concrete

For the smart transparent concrete, the interfacial bonding of the POFs and concrete is a crucial factor in determining ultimate impermeability properties. The chloride diffusion coefficient method (or electric flux method) is used to test the impermeability property of smart transparent concrete, which can rapidly evaluate the permeability of concrete by measuring the electric energy through concrete. In this paper, the smart transparent concretes with 0%, 3% and 6% POF volume ratio are chosen for the test. The electric energy is recorded by the electric flux detector NJW-RCP-6A made in China, and cylindrical concrete specimens with 100mm diameter and 50mm height are fabricated from the prefabricated smart transparent concretes by core-drilling method

General Properties of Translucent Concrete

5. APPLICATION

The main advantage of transparent concrete is that it can transmit light. There, it can be used to make green buildings. Since it can transmit light from natural as well as artificial sources, the building can have fewer lights to meet its demand for lighting. Thus saving huge energy cost.

Transparent concrete uses sunlight as source of light instead of electrical energy and reduces power consumption. This concrete can also be used cold countries to transmit heat with sunlight. Translucent concrete is not currently widely produced. There are only a select few companies, and the process is somewhat low-tech and slow. It can only be produced as pre-cast or prefabricated blocks and panels; it cannot be poured on site like traditional concrete. The blocks come in a range of sizes, the maximum for glass fibre being 1200 x 400 mm (47.2 x 15.7 inches), and the thickness can range from 25-500mm (1-20 inches). This allows translucent concrete to be used for a variety of purposes, from a thin veneer to a structural system. According to one German company, it can be used “for ventilated facade systems as well as for interior cladding”. So far translucent concrete has been used to make light installations, signs, and fixed-in-place furniture such as benches, desks, and counters. In its early days, it was used mostly in art installations and material demonstrations such as the Liquid Stone exhibit at the National Building Museum, and a sidewalk in Stockholm that looked “like an ordinary sidewalk by day but illuminated at night by lights under it”. It is presently used mostly in interiors as decoration, but is making its foray into exterior structural walls.

6. CONCLUSSIONS

a. The addition of E-waste shows increase in compressive strength upto 15% replacement.

b. Increase in split tensile strength is almost insignificant whereas gain in flexural tensile strength have occurred even up to 15% replacements. E-waste seems to have a more pronounced effect on the flexural strength than the split tensile strength.

c. The use of E-waste in concrete is possible to improve its mechanical properties and can be one of the economical ways for their disposal in environment friendly manner.

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