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"LUMINOUS PAVER BLOCKS" ILLUMINATING BLOCKS WITH SAFETY AND AESTHETICS

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ABSTRACT:
Energy demand is unrelenting and escalating daily in developing nations. One of the main problems facing the government is road illumination. This research presents a look into the inclusion of photo luminescence feature in paver blocks. Luminous materials with varying percentage, such as strontium aluminates, titanium dioxide and resins, have been used to give paver blocks a gleaming appearance. It has been identified that material used for the manufacture of paver blocks has substantial compressive strength and has the ability to emit light. Coat on surface of paver block found to have a good strength than luminous paver block and equivalent to conventional paver block.
Keywords: Luminous Paver blocks, Photo luminescence, Resins, Strontium aluminates, Titanium Dioxide.

1. INTRODUCTION:

A Luminous paver block also known as glow in dark (GID) or light emitting, is one that has the capacity to share solar or artificial energy during the day and convert it into visible light at night. Improper lighting and visibility in some areas at night can leads to many social problems and accidents. The importance of luminous paver is found in their capacity to create light without the use of electricity or other sources of energy. These attributes make paver blocks an economical and environmentally friendly alternative to conventional outdoor lighting. The material used to make luminous paver blocks often contains phosphorescent pigments, which absorbs light and release it in a way that reflects light in the dark. The luminance material used in paver blocks is available in variety of hues, such as green, blue and white and it may endure for many years without fading or losing its brightness. The blocks are normally set up like regular concrete pavers, but they also have the additional benefit of creating a special lighting effect at night. The technique of installation is the same as for regular paver blocks. To completely charge the phosphorescent pigments, it's crucial to make sure the pavers receive enough light during the day. The paver block can be placed in areas that get direct sunlight to achieve this, or lighting fixtures that provide enough artificial light can be installed to charge the pavement.

2. LITERATURE REVIEW:

Dr. M Mageshwari, A.R. Rinisha, Y. Monisha (Dr. M. Mageshwari, 2021):
This research paper describes the basic principle of phosphorescence in which the phosphorescent materials absorbs light in daytime and emits the light in darkness. It assures study glow supply up to 12 hours, has aesthetic appeal and can be extensively used in construction. The material they used in project is phosphorescent material, solvent and borosilicate glass powder. The phosphorescent material is mixed with the solvent in the ratio of 2:1. The investigation suggests that the percentage of phosphorescent materia (Hadi Barghlame)l can be increased by 50% to improve the glow.

Muhammad Saleem, Nawaf. I. Blaisi (Muhammad Saleem, 2018):
The research paper work deals with the development, testing and environmental impact assessment of glow in dark concrete. Through experimental, 20% GID addition was found to be the optimum dosage for glow in dark concrete. Mechanical tests consisting of strength, skid resistance, thermal cycling and glow intensity and duration were conducted on the prepared prototype. In addition,

environmental impact assessment and toxicity testing were conducted. The research work is based on the use of strontium aluminates, a GID powder in concrete for the development of new type of interlock blocks that can be applied in infrastructure projects. Glow in dark powder was used in three different proportions that are 10%, 15% and 20% by mass of cement. Glow in dark concrete interlock block specimens showed good resistance against thermal cycling and also performed exceptionally well in skid resistance test.

Prof. S. Sundari, A. Shriswarnambigai (Bigai, 2021):

This paper provides an investigation of the luminescent property of a concrete by modifying the property of cement. The photo luminescent pigment used in this paper is a sulphide powder, titanium powder and resins. The luminescent concrete comprises preparing slurry. The slurry is prepared by mixing sand, gravel, cement and water. After mixing, luminous material is added i.e. titanium powder, sulphide powder and resins. The slurry is poured into mould. The mould is kept for at least 12-14 hours. Objectives of the research was to create samples of photo luminescent concrete which gives rise to the idea that concrete can provide functions beyond the structure, and as such can be used in a wider array of application.

Hadi Barghlame, Hojjat Hashempour Gavgani (Hadi Barghlame):

This paper provides various light emitting concrete composition and method of synthesizing a light emitting concrete structure. The light emitting concrete composition comprises light emitting pigments. It include a titanium powder, a sulphide powder, resins, gravel ,sand, cement and water. The slurry is prepared by mixing sand, gravel, cement and water. The light emitting pigment mixture is prepared by adding a titanium powder, resins and a sulphide powder to slurry. The slurry is moulded in the mould and kept at a temperature of 15-20º C for at least 12-14 hours. The slurry is cured at temperature of less than 30º C for 24 hours. The primary objectives of the embodiments herein is to provide a lght emitting concrete composition that is an admixture that is capable of emitting light even after the sources of light is removed.

Andrew Wiese, Taylor Washington, Berine Tao & William Jasem Weiss (Andrew Wiese, 2015):

Objective of this research was to develop a soy- based luminescent sealant for use on concrete surface. The luminescent sealant used was mixture a soy- methyl ester polystyrene powder. In this study, a test producer was developed to quantity the magnitude and duration of the luminance of the coated concrete surfaces, quantifying the luminance was key in evaluating the performance of the luminescent sealant. Results of the tests indicated that the luminescent surface emitting light for approximately 24 hours in a dark space after it was excited. Larger particles of strontium aluminates were found to luminance for a longer time than did smaller particles.

3. OBJECTIVE OF THE PROJECT:

I. To investigate the suitable proportion of luminous material with concrete ingredients to achieve desirable glow intensity during sufficient duration.
II. To conduct mechanical testing of the specimens to evaluate their real-world feasibility.
III. To test for luminance, it is performed by leaving the paver block exposed to sunlight or artificial light for 24 hours, and then keeping it in darkness for the luminance check.
IV. To study cost effectiveness of luminous paver blocks.

4. METHODOLOGY:

It outlines the methods of the current study as well as the characteristics of various materials used in the manufacturing of luminous paver blocks with the M 35garde destination which contain OPC 43 cement. The specifics of the testing procedures used to look into the hardened characteristics of luminous paver blocks are described. For M 35 grade, concrete mix design is also carried out.

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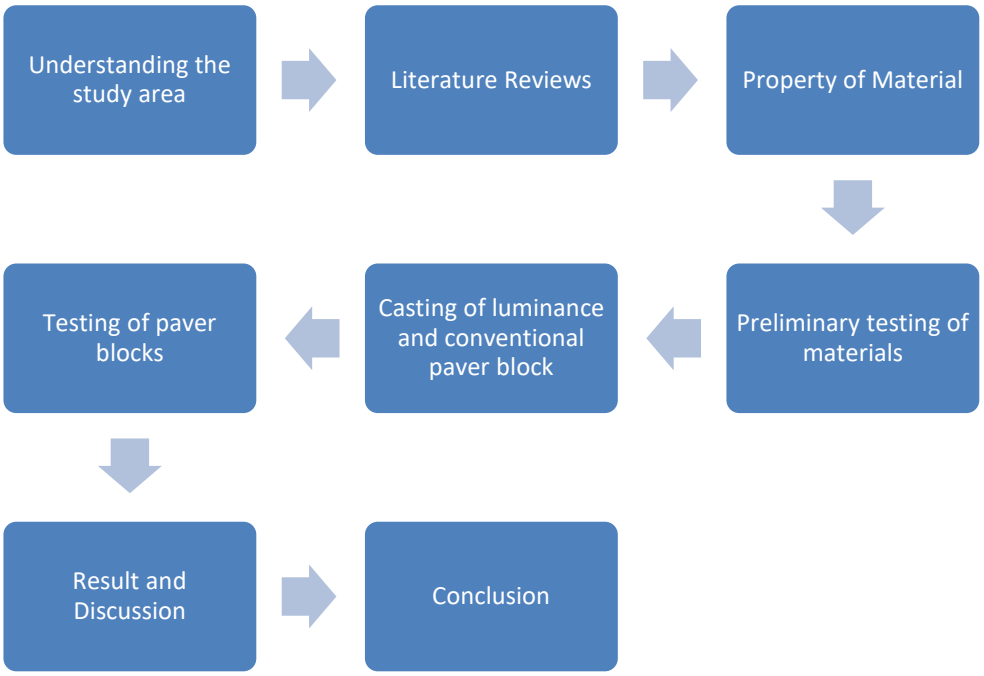

Table – 1- Flow chart

5. METHOD OF PREPARATION:

The following procedure can be used to prepare the luminous paver blocks **(Bigai, 2021):**

A. Mixing the Luminous Component.
B. Modifying the microstructure of cement.
C. Coating the surface with luminous component.

Out of above three approaches mentioned above, the method that involves mixing the luminous component and the method that involves coating the surface with luminous component has been used in this project.

6. LUMINOUS MATERIAL:

(i) Strontium Aluminates:

Strontium Aluminates is a chemical compound with the formula $SrAl_2O_4$. It is a Pale Yellow, Monoclinic crystalline powder that is odorless and non- flammable. Strontium aluminates absorb and stores energy when exposed to light, and when placed in a dark environment, it releases that energy as light. It is a desirable replacement for conventional phosphorescent materials due to its extended afterglow and great brightness.

(ii) Titanium Dioxide:

Titanium dioxide also known as titania, is a white, naturally occurring mineral with the chemical formula TiO_2. It is commonly used as a pigment and a thickening agent in a variety of products such as paints, sun cream, food and cosmetics. It has excellent opacity, ultraviolet (UV) resistance and is also good photo catalyst.

(iii) Resins:

Resins are synthetic or natural materials that are used extensively in various industries, primarily in construction and manufacturing. They are a specific type of polymer that undergoes a process of curing or hardening when exposed to certain conditions such as heat, pressure or specific chemical.

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7. CASTING OF PAVER BLOCKS:

Conventional paver block and luminous paver blocks were cast in order to evaluate their quality in both the fresh and hardened stage. Suitable care was taken for filling the paver moulds of specimens. The compressive strength and luminance test specimen were taken as 03 in number for each stage of 07, 14 & 28 days of curing for both conventional & luminance paver blocks. In each grade M 35, 60mm thick paver blocks were casted as per IS: 15658: 2021.

Fig – 1- Luminous Materials

Fig – 2 – Mixing of Concrete Mix

Fig – 3 –Setting of paver blocks

8. COMPRESSIVE STRENGTH TEST RESULT:

Tests were done for 7th, 14th and 28th day's compressive strength.

8.1 Conventional Paver Block:

Average Compressive strength obtained at 7th days = 16.87 N/mm^2.
Average Compressive strength obtained at 14th days = 24.09 N/mm^2.
Average Compressive Strength obtained at 28th days = 32.48 N/mm^2.

8.2 Luminance Paver Blocks:

Average Compressive strength obtained at 7th days = 14.88 N/mm^2.
Average Compressive strength obtained at 14th days = 22.12 N/mm^2.
Average Compressive Strength obtained at 28th days = 29.60 N/mm^2.

8.3 Coat on surface of Paver Block:

Average Compressive Strength at 28th days = 32.67 N/mm^2.

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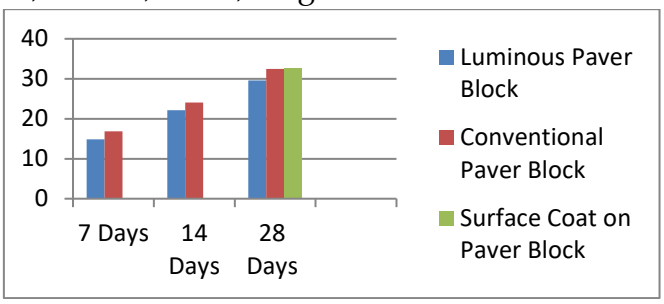

Fig- 4– Graphical representation of paver block strength

8.4 Conventional Cubes:

Average Compressive strength obtained at 7th days = 22.77 N/mm^2.
Average Compressive strength obtained at 14th days = 31.24 N/mm^2.
Average Compressive Strength obtained at 28th days = 35.17 N/mm^2.

8.5 Luminance Cubes:

Average Compressive strength obtained at 7th days = 18.51 N/mm^2.
Average Compressive strength obtained at 14th days = 27.40 N/mm^2.
Average Compressive Strength obtained at 28th days = 33.94 N/mm^2.

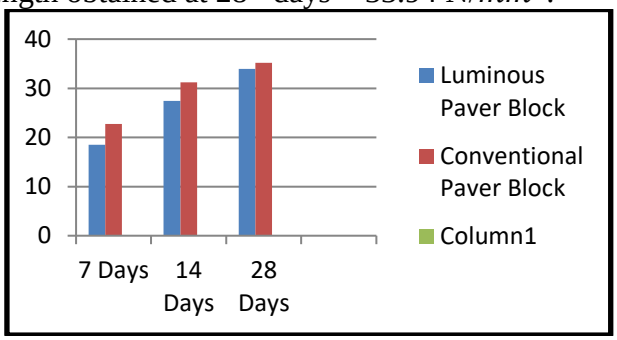

Fig-5- Graphical representation of cubes strength

9. LUMINANCE TEST:

A frequently used technique is to assess the luminance or brightness of the paver blocks under particular circumstances in order to test the luminance performance of the blocks. The blocks are tested by being exposed to a certain type of natural or artificial light for 12 hours, after which the blocks are maintained in the dark to measure luminosity.

S. No.	Luminous Material%	Result
1.	3% Titanium Dioxide 3% Strontium Aluminates 6% Resins	Not glowing
2.	3% Titanium Dioxide 5% Strontium Aluminates 9% Resins	Was glowing brightly for around 6 hours, after which it might not have been able to recharge.
3.	Coated on surface	Glowing and capable of self-recharging.

Table-2- Result of Luminous test on paver Block

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10. COAT ON SURFACE:

Fig- 6- Coat on surface of Paver Block

S. No.	Time Taken for Light Absorption	Duration of After Glow
1	30 Seconds	15 Minutes
2	10 Minutes	30 Minutes
3	1 Hour	90 Minutes
4	12 Hours	15 Hours

Table –3- Duration of luminous paver block

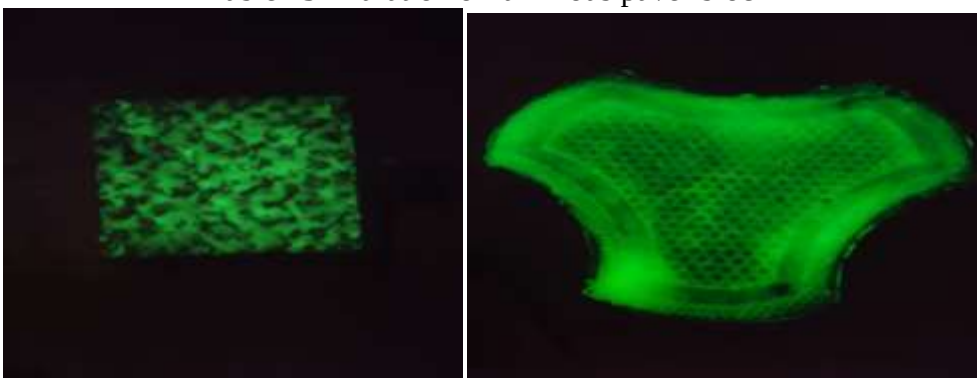

Fig – 7 – Luminous Glow effect

11. COST ANALYSIS:

Paver Block rate per block:

S.NO.	PAVER BLOCK	RATE	COST OF 1 PAVER BLOCK
1	Conventional Paver Block	1136 / 33	34/- per block
2	Luminous Paver Block	2560 / 33	77/- per block
3	Surface coat on Conventional Block	34 + 20	54/- per block

Table – 4- Cost of Paver Blocks

12. CONCLUSION:

This experiment will serve as an incentive for future research into innovative building technology that is currently under development. Innovative paver blocks made of luminous materials have been constructed that can be used at numerous infrastructure locations.

(i) For this project, we cast paver blocks with various percentages of luminous materials. We observed that the paver blocks lost their glow in 3% strontium aluminates, 3% titanium dioxide and 6% resins were added.

(ii) Paver block was glowing for about 6 hours in addition to 5% strontium aluminates, 3% titanium dioxide and 9% resin, but after that it was unable to glow and was unable to recharge itself.

(iii) The result of coating a paver block's surface with luminescent materials is that it was glowing for around 7 hours and could be recharged by both natural and artificial light. Coat on surface found to be effective in paver blocks.

(iv) Luminance paver block cost more than conventional ones. The price of luminous materials may drop significantly when used in huge quantities.

(v) The project has helped us to learn about the effect of photo luminescent properties on the strength of paver block. Coat on surface of paver block found to have a good strength than luminous paver block and equivalent to conventional paver block. Large scale application of photo luminescence- induced paver block would show to be a perfect substitute for current lighting technologies with regard to country's housing and its roadways.

13. FUTURE SCOPE:

- **A.** Further study needed for the compatibility of cement with luminous material and can explore the development of self-healing cement using strontium aluminates.
- **B.** Can focus on improving the durability, strength, and energy efficiency of these blocks, making more suitable for heavy traffic areas and roads.
- **C.** The present work was conducted using grey cement. It believe that similar studies can be conducted by using cement with varying colour pigments.

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