

DEVELOPMENT OF COST-EFFECTIVE SUSTAINABLE ROOF TILES INTEGRATED WITH SOLAR ENERGY HARVESTING

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College : Vidya Vikas Institute of Engineering & Technology, Mysuru.
Branch : Department Of Civil Engineering
Guides(S) : Prof. Anusha G S
Student(S) : Ms. Anusha S
Mr. Dhanush S
Mr. Mahesh Kumar M
Ms. Sakshi N

Keywords

Sustainable solar roof tiles, Renewable energy integration, Recycled fiberglass materials, Cost-effective & eco-friendly construction, Photovoltaic energy generation.

Introduction

In India, rapid urbanization and rising energy demands have intensified the need for affordable housing and sustainable energy solutions. Conventional roof tiles are often manufactured using resource-intensive materials that contribute to environmental degradation, while solar panels, though effective for renewable energy generation, remain expensive and challenging to integrate seamlessly into low- and middle-income housing. A critical need to develop cost-effective roof tiles manufactured from sustainable materials, embedded with solar energy harvesting capability, to serve as a dual-purpose solution: providing durable roofing while simultaneously generating clean electricity.

Objectives:

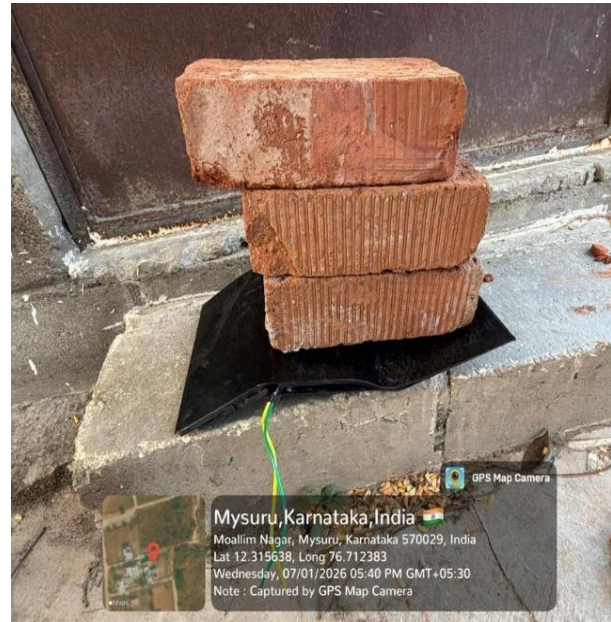
1. To design and develop durable roof tile by using sustainable and cost-effective raw material integrated with photovoltaic cells.
2. To maintain durability, strength, and weather resistance while ensuring efficient solar energy generation.
3. To conduct comparative cost benefit and energy output analysis against conventional roofing and solar panels.

Methodology:



Results

The developed solar roof tile demonstrates efficient performance by generating 7–15 V under sunlight while maintaining a current capacity of around 800 mAh. It is significantly lightweight (0.5 kg) compared to conventional tiles, reducing structural load without compromising strength, as it can withstand up to 10.5 kg. Additionally, with an estimated cost of ₹2000, it offers an economical and sustainable roofing solution. Overall, the tile combines energy generation, durability, and cost-effectiveness effectively.



Conclusion

The project confirms that solar-integrated roof tiles are a practical, cost-effective, and sustainable solution, combining structural functionality with renewable energy generation. The system offers reliable performance, reduced environmental impact, and suitability for small-scale residential applications. Its lightweight, modular design further ensures easy installation, scalability, and adaptability across different conditions.

Reference

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Scope For Future Works

1. Increased use of recycled fiberglass and waste plastics can further reduce raw material consumption. Optimization of design can lower manufacturing cost while maintaining structural strength.
2. Mass production of the tiles can significantly reduce overall cost per unit. Eco-friendly materials help minimize construction waste and environmental impact.
3. Reduced carbon footprint compared to conventional roofing and solar panels. Suitable for green buildings and sustainable housing projects.