SOLAR ROOF TILE: INTRO.

Prof. Shreedhar Patil1, Apekshit Suryawanshi2, Komal Sawant3, Anam Momin4, Akash Potenavru5

Department of Civil Engineering, Dr. D Y Patil School Of Engineering and Technology, Lohgoan.

ABSTRACT

In India Majority of the population live in rural areas, there is much scope for solar energy. India has massive plan for Solar Energy generation. India is not only fulfilling the power generation but also contribute largely in Green Energy. Use of solar energy can reduce the Air pollution happen due to firewood.

Solar energy is clean, environment-friendly potential resource among renewable energy options. One of the best of solar energy source is PV roof tiles. Solar Roof tiles in particular provide an ideal site for photovoltaic electrical power generation. Roof structures can provide a significant contribution to electricity generation.

The aim of this paper to cover the importance of solar energy and PV roof tiles, future scope, recent advances in natural fiber, epoxy composites and Nano composites research study, including manufacturing PV solar tile by using local materials.

Keyword: PV roof tile (solar roof tile), epoxy resin, natural fiber

1. INTRODUCTION

In urban areas where land space is at a valuable, such large areas are especially attractive. Roofs in particular provide an ideal site for photovoltaic electrical power generation. In general they represent large, flat surfaces which are less prone to shading than walls and exhibit more favourable inclinations for solar gain. Solar panels should be inclined perpendicular to the sun’s rays for the more sunlight gain. A roof mounted structure cannot satisfy these criteria and so a tilt angle of near 45 degrees is likely to represent a good compromise.

As a first step to achieving this goal PV roofs have been installed using standard modules which are laid side by side across a roof deck. A capping is placed between the modules to ensure a watertight seal.

This process however, requires a complex aluminium framing structure to be mounted onto incline angle. The savings which result from the dual use of the photovoltaic are negated by the high cost of the framing and mounting structure. Although the finished roof represents a major advance aesthetically over earlier bolt on solutions, the stepped effect obtained with traditional roofs, made of tiles is lost.

In order to develop a photovoltaic roof tile it is first necessary to understand current roofing practice and materials. In the U.K., The tiles are laid on wooden battens which run along the roof and are attached by special fixture. The battens are in turn nailed onto the rafters of the roof structure. A secondary level of protection is provided by a sharking felt which is laid between the rafters and the battens. This material provides insulation, prevents dust and air entering and water.

2. LITERATURE REVIEW

i. VijayaKumar Eesarapu1, Saidulu Pagidipalli2, V Suresh3, G V Ramesh Kumar4, STUDY AND TESTING OF GLASS FIBRE REINFORCED PLASTICS. This paper includes the investigation and studies the epoxy/polyester composites which are used in aerospace. The paper includes six tests Tensile, Flexural, Heat distortion, Izod impact, Hardness test, Water absorption. The conclusion of this paper is glass fibre composites which are made from combination of epoxy and glass fibre have high strength, low weight, high stiffness, low water absorption high heat distortion temperature and average impact strength.

ii. A.H.M Fazle Elahi 1, Md. Milon Hossain 2, Shahida Afrin3, Mubarak A. Khan4, STUDY ON THE MECHANICAL PROPERTIES OF GLASS
FIBER REINFORCED POLYESTER COMPOSITES. This paper includes the study of Glass fiber. GFRP based polymer composite was prepared using hand layup process. Four layers of GF were impregnated by polyester resin. Then it is pressed under load of 5kg for a day. Then the material was heat treated from 60 degree Celsius to 150 degree for 1 hour and finally taken for mechanical test. Tensile strength, tensile modulus, elongation at break, impact strength, shear strength and hardness of the fabricated composite were calculated. the mechanical property gives the best result of the fabricated composite from the heat treatment. The maximum tensile strength of 200.6 MPa is found for 900C heat treated sample. Finally, the excellent heat resistant capacity of GFRP composite shows the suitability of its application to heat exposure areas such kitchen furniture materials, marine, electric board etc.

iii. S. Bahaj & P.A.B.James, PHOTOVOLTAIC ROOF TILES: DESIGN AND INTEGRATION IN BUILDINGS, this paper includes study of solar roof tile styles, designs and various methods of installation. The photovoltaic (PV) roof tile structures can provide contribution to electricity generation. A design for a PV roof tile is proposed which will enable seamless integration with standard tiles. The constraints imposed by this requirement are discussed along with aesthetic, commercial and regulatory issues. In this way, a new style in the integration of photovoltaic buildings can be seen.

iv. Swami Prakash Srivastava1 Surat Prakash Srivastava2 SOLAR ENERGY AND ITS FUTURE ROLE IN INDIAN ECONOMY this paper includes the study of about solar power missions. The objective of the India is a global leader in solar energy, by creating the policy conditions for its diffusion across the country as quickly as possible. The immediate aim of the Mission is to focus on setting up new solar technology penetration in the country both at a centralized and decentralized level. The National Action Plan on Climate Change also points out: “India is a tropical country, where sunshine is available for longer time per day and in great intensity. Solar energy, therefore, has great potential as future energy source.

v. Erich Christian Metten1, Timothy James Roddick2, PHOTOVOLTAIC SOLAR ROOF ASSEMBLY SYSTEM, The invention provides a modular system that includes a composite tile, With or Without integrated photovoltaic cells, the paper includes assembly of the tiles to a structure, and a wiring system for the photovoltaic tile. The track tiles are made of composite material. Moulding can be used for the manufacturing of the track lengths are fastened to the structure. The track and tile have mating features, such that the tile can be interlocked with each other. Adjacent tiles are installed with overlap. Photovoltaic cells can be moulded into or assembled with the tile. A Wire harness is assembled to the track when the photo voltaic tile is interlocked. The connectors of the photovoltaic cells engage the Wiring harness to provide an electrical connection.

vi. Chandrakant Dondariya a, Deepak Porwal a, *, Anshul Awasthi a, Akash Kumar Shukla a, *, K. Sudhakar b, c, Murali Manohar S.R. a, Amit Bhimte a “PERFORMANCE SIMULATION OF GRID-CONNECTED ROOFTOP SOLAR PV SYSTEM FOR SMALL HOUSEHOLDS: A CASE STUDY OF UJJAIN, INDIA”, this paper includes Solar rooftop PV system is an attractive and alternate electricity source for home. The potential of solar PV at a given site can be evaluated through software tools. This study is done to assess the feasibility of grid-connected rooftop solar photovoltaic system for a household building in holy city Ujjain, India. The study focuses on the use of various simulation software, PV*SOL, PVGIS, Solar GIS and SISIFO the energy generation, performance ratio and solar fraction for performance prediction of this solar power plant. PV*SOL demonstrates to be easy to handle and reliable software tool.

vii. Naheed Saba1, Mohammad Jawaid1,2, Othman Y Alothan2, MT Paridah1 and Azman Hassan3 “RECENT ADVANCES IN EPOXY RESIN, NATURAL FIBER-REINFORCED EPOXY COMPOSITES AND THEIR APPLICATIONS” this paper includes The versatile characteristic of epoxy. Its diversity made it suitable for different industrial applications. Use like laminated circuit board, electronic component encapsulations, surface coatings, potting, fiber reinforcement. However, the pervasive applications in many high-performance fields limited the epoxy used, because it have low impact resistance, inherent brittleness, and fracture toughness behaviour. The limitations of epoxy can be
overcome by incorporation and modification before their industrial applications. The modified epoxy resins are used in fabrication of natural fiber. Making its different industrial products because of their superior mechanical, thermal, and electrical properties.

Bharat Raj Singh*1 and Onkar Singh2 FUTURE SCOPE OF SOLAR ENERGY IN INDIA”, As per the geographical location of the country, India has tremendous scope of generating solar energy. Solar Power Generation alone can cater more than 60-65% of our entire need of power. Thus, we have to focus future plans of installing large projects. In Rajasthan and Jammu & Kashmir where as in Uttar-Pradesh, Banda district - is most suitable location for solar energy generation. Apart from above, we also have to focus on Roof Top Solar Energy Generation. It may cut down our need to more than 50% for the every house.

3. FUTURE SCOPE

3.1. Historical Growth of the Solar Market in India

The Rural Electrification Program started in 2006. It was the first step by the Indian Government in recognizing the importance of solar power. It gave guidelines for the implementation of off-grid solar applications. However, at this early stage, only 33.8MW of capacity was installed. This primarily included solar panels, pumps, home lighting, street lighting and solar home. In 2007, India started the Semiconductor Policy for growing the electronic and IT industries. The Generation Based Incentive (GBI) scheme, announced in January 2008 was the first step by the government to promote grid connected solar power plants.

3.2. Present Status and Installed Capacity of Solar Energy in India

Solar power has so far played an almost non-existent role in the Indian energy mix. The grid-connected capacity (all PV) in India now stands at 481.48 MW as of 31st January 2012. However, the market is set to grow significantly in the next ten years, driven mainly by rising power demand and prices for fossil fuels, the ambitious National Solar Mission (NSM), various state level initiatives, renewable energy quotas including solar energy quotas for utilities as well as by falling international technology costs. India’s government has begun to acknowledge the importance of solar energy to the country’s economic growth. Prime Minister Manmohan Singh, who has said solar energy will transform rural India, launched a National Solar Mission in 2010. Initial growth has been dramatic, albeit from a tiny base. From less than 12 MW in 2009


The Mission aims at development of solar energy technologies in the country. The mission is achieving parity with grid power. The objective of the National Solar Mission is to establish India as a global leader in solar energy. The aim would be to protect Government from subsidy exposure

1. The main features of the National Solar Mission are:
2. Make India a global leader in solar energy and the mission envisages an installed solar generation capacity of 20,000 MW by 2022, 1, 00,000 MW by 2030 and of 2, 00,000 MW by 2050.
3. The total expected investment required for the 30-year period will run is from Ru. 85,000 core to Rs. 105,000 core.
4. Between 2017 and 2020, the target is to achieve tariff parity with conventional grid power and achieve an installed capacity of 20 giga watts (Gw) by 2020.
5. 4-5GW of installed solar manufacturing capacity by 2017.
6. To deploy 20 million solar lighting systems for rural areas by 2022

3.4. Solar Energy Development In different States:

The Gujarat solar policy has their own policy frameworks independent of the federal guidelines. These policies are independent to each other as well as the NSM. Other states like Karnataka, Andhra Pradesh and Rajasthan have followed suit in developing solar power development programs. Rajasthan has implemented land banks as well to make land acquisition easier. As more states plan to meet their solar power obligations, new policies are expected to be offered, creating as very vibrant set of markets across the subcontinent.

3.5. Future Growth of Solar in India

The solar industry's structure will rapidly evolve as solar reaches grid parity with conventional power between 2016 and 2018. Solar will be seen more as a viable energy source. It is not just as alternative renewable sources but also to a
significant proportion of conventional grid power. The testing and refinement of off-grid and rooftop solar models in the seed phase will help lead to the explosive growth of this segment in the growth phase. Global prices for photovoltaic (PV) modules are dropping cost due to use of solar energy. Its reducing the overall cost of generating solar power. In India average prices is 15 to 17 cents per kilowatt hour (kWh).

3.6. future of solar energy in India

1. In solar energy sector, many large projects have been proposed in India.
2. Thar Desert has some of India’s best solar power projects estimated to generate 700 to 2,100 GW.
3. On March 1st, 2014, the then Chief Minister of Gujarat, Narendra Modi, inaugurated at Diken in Neemuch district of Madhya Pradesh, India’s biggest solar power plant.
4. The Jawaharlal Nehru National Solar Mission (JNNSM) launched by the Centre is targeting 20,000 MW of solar energy power by 2022
5. Gujarat’s pioneering solar power policy aims at 1,000 MW of solar energy generation.
6. In July 2009, a $19 billion solar power plan was unveiled, which projected to produce 20 GW of solar power by 2020.
7. About 66 MW is installed for various applications in the rural area, amounting to be used in solar lanterns, street lighting systems and solar water pumps, etc.

4. HOW DO SOLAR TILES WORK?

The tiles are formed by photovoltaic cells. When they receive sunlight, create an electric field capable of providing electrical energy for use inside the building. Each tile is connected by cables to the power distribution board.

For the effective operation of the tiles, it is necessary to install an inverter that converts the energy captured by each tile into electricity. Another alternative is to install a solar diverter, or a 'domestic solar system', always with supervision of a professional.

The quantity of energy collected through solar energy is directly related to the amount of sunlight to which the tiles are exposed, which is obviously related to the climate and the location of the project. Sunny days, of course, are more energy-efficient than cloudy days.

To ensure maximum efficiency, it is essential to maintain and clean the tiles. In addition, it's recommended to choose solar tiles that are arranged next to each other rather than overlapping (unlike traditional ceramic tiles), since this prevents shadow areas from being generated that don't capture sunlight.

5. ABOUT SOLAR ROOF

Physical specification
- Width 250 mm
- Height 15 mm
- Length 250 mm
- Individual tile weight = 500 gm.

Electrical specification
- Voltage max =5 V
- Current max = 3A

5.1. Advantages
1. Solar tiles are an excellent source of renewable energy for regions with high solar incidence.
2. They are visually more attractive than traditional photovoltaic panels since they are part of the roof design.
3. There are some solar tile options that even mimic the appearance of slate stone tiles or ceramic tiles, going completely unnoticed.
4. They are a good option for generating the solar energy and conservation and/or in historical areas (when alterations are authorized).

5.2. Disadvantages
1. They are new to the market and, therefore, are even more expensive than traditional photovoltaic panels.
2. There are still few solar tile manufacturers and few skilled labourers for its installation.
3. Unlike solar panels, they cannot be installed at angles other than the original roof design, so in some cases, it's more difficult to optimize the efficiency of energy capture. However, this can be an advantage if the roof is designed correctly.
for this purpose, accounting for the tiles in the very concept of the project.

6. MATERIAL

6.1. Fiber glass :-
Glass fibre is a lightweight, extremely strong, and robust material. The material is less brittle, and the raw materials are much less expensive. Its bulk strength and weight properties are also very favourable. It can be easily formed using moulding processes. Glass fibres used for insulation, for the final structure to be strong, the fibres surfaces must be almost entirely free of defects; this permits the fibres to reach GPA tensile strengths. If a bulk piece of glass were to be defect free, then it would be equally as strong as glass fibre’s; however it’s generally impractical to produce and maintain bulk material in a defect free state, although it can be done under laboratory conditions. Composites are made up of individual materials referred to as constituent materials.

6.2. Epoxy resin:-
Epoxy resin has light weight, high performance and excellent mechanical properties. Carbon fibers are considered a key material in the 21st century. These are extensively used in many industries like structural usages, aerospace, aeronautical, sporting goods applications. It is also used in automotive and medical devices, due to their desirable strength to weight properties. Now, these are globally accepted as a high performance and high-strength material. Most of the carbon fibers are derived from polyacrylonitrile fiber precursor. These materials have the potential for fire hazards caused due to heat, smoke, and electric short circuit.

The versatile characteristic of epoxy and its diversity made it suitable for different industrial applications. Epoxy resin is used for laminated circuit board, electronic component encapsulations, surface coatings, potting, fiber reinforcement and adhesives. Epoxy use due to their delamination, low impact resistance, inherent brittleness and fracture toughness behaviour. The limitations of epoxy can be overcome by incorporation and modification. The modified epoxy resins are extensively used in fabrication. It is used in making its different industrial products due to their superior mechanical, thermal and electrical properties.

6.3. Solar cell:-
The fabrication of solar cells has passed through a large number of improvement steps from one generation to another. Silicon based solar cells were the first generation solar cells grown on Si wafers, mainly single crystals. Further development to thin films, dye sensitized solar cells and organic solar cells enhanced the cell efficiency. The development is basically hindered by the cost and efficiency. In order to choose the right solar cell for a specific geographic location, we are required to understand fundamental mechanisms and functions of several solar technologies that are widely studied.

7. SOLAR TILE DESIGN (BY USING ALTE CALCULATOR) :-

Daily energy usage = 100 watt (assume)
The average sun hours = 3 hr.
The total wattage of Solar Panels that you need in 3 hr. = 42.5 watt
Solar cells required (about 24 V) = 3 no.
The power generate from each tile = 0.25 A

8. CONCLUSION:-
A design such as that described in this paper, The PV roof tile represents the combination of a mature tile industry, with state of the art plastic and photovoltaic technologies. In this way, a new approach to the integration of photovoltaic in buildings can be realised.

REFERENCE
[2] Bharat Raj Singh*1 and Onkar Singh2, FUTURE SCOPE OF SOLAR ENERGY IN INDIA, 2022
[4] Naheed Saba1, Mohammad Jawaid1,2, Othman Y Alothman1, MT Paridah1 and Azman Hassan3, RECENT ADVANCES IN EPOXY RESIN, NATURAL FIBER-REINFORCED EPOXY COMPOSITES AND THEIR APPLICATIONS, Malaysia on November 25, 2015


[9] Erich Christian Metten, Timothy James Roddick, PHOTOVOLTAIC SOLAR ROOF ASSEMBLY SYSTEM, JAN 12, 2014