International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 09 Issue: 12 | Dec - 2025 SJIF Rating: 8.586 ISSN: 2582-3930

Solar Panels with Modified Geometry for Efficient Energy Collection

R. Aditya[1], K. Vanaja[2], S. Meghana2 , V. Varshitha[3], P. Lahari[4]

[1,2,3,4] *Department of Mechanical Engineering, Vignan's Institute of Engineering for Women, Visakhapatnam, India,530049*

---***---

Abstract - As the world is going towards renewable energy sources, solar panels are being in use widely. Here a flat solar panel and semicircular solar panels are prepared according to the real model applications. The voltage and current values at the output terminals are collected for four different times in a day. A graph is drawn to compare voltage and current values of flat and curved panels. It is observed that in all observations, semicircular panels are occupying less space compared to flat solar panels and yielding higher voltage and current outputs.

Key Words: Flexible solar panels, Multimeter, Compact energy collection, Solar films

1.INTRODUCTION

Solar energy is a one of renewable energy sources. A solar panel is small solar cells those hold sunlight. Solar panels are used for cars, lights, chargers, fans and also to run homes. Flexible solar panels are very light to carry and fix. It can be bent to fit on different curved shapes [1]. Currently in solar panels the efficiency and durability is to be improved. Different materials can be used to achieve this. Both silicon-based panels and new types of panels like Cadmium-Tellurium (CDTE), Cadmium-Indium-Gallium-Selenide CIGS can be used. Coatings and polymers improve performance and suggest future directions for Solar Technology [2].

Solar Cell Technology has divided into four generations. It has grown as cleaner alternative for fossil fuels. In these four generations. Role of graphene in Solar Cell is also observed in latest generation solar panels [3]. Flexible solar panels are light, strong, and can bend to fit different surfaces like curved rooftops. Different new materials to make a solar panel, shape and size of panels is affecting the performance. Sustainable energy solutions are taking new dimensions with the discovery of new materials and their manufacturing methods [4]. Flexible thin-film solar cells are light weight and strong and also can be used in many things like cars, tents etc. different materials will have different advantages and disadvantages and future possibilities [5].

This bending of solar panel is important. The cells made of plastic with special organic layers and electrodes. Stress and strain of solar panels affect performance of panel [6]. Researchers have improved flexible solar materials made from special materials like TMDs by solving the problems which are limited their performance previously. Using graphene leads to protective coating [7]. Flexible perovskite silicon solar cells are very efficient but stress and charge transfer reduces the performance of them. This study are being done to solve the problem by making the perovskite layer more uniform and improved stability and efficiency to nearly 30% [8].

Researches improved fully printed flexible perovskite solar cells by adding a special layer that reduces energy loss . The cells achieved good efficiency, stayed stable after repeated bending and performed well under heat and humidity [9]. Using flexible solar panels on cars can generate electricity from sunlight. Curved panels reduce drag as compared to flat ones [10]. Flexible organic cells can bend, durable and efficient. The cells keep most of their performance even after bending or folding, making them suitable for wearable devices [11].

Solar power is now very cheap and to understand that we need to know how solar panels work and how they are made. Most panels use types of silicon, this article explain the manufacturing processes and their parts [12]. There is need for compacting the solar panels to accommodate on small roof tops of India for domestic needs. This work aims to bend a flexible solar panel in to semicircular shape and comparing it's power output with that of flat panels. This study tries to occupy the less space compared to flat panels and obtaining high power out puts.

2. Materials and methods

1.1 Materials

Solar cell materials: Silicon which is known for its better semiconducting properties is used to make solar cells. Cadmium telluride (CdTe) and copper indium gallium selenide (CIGS) thin film semiconductors are also used to obtain highly efficient solar cells.

1.2 Methods

Two flexible solar panels are taken, one is flat with 210 mm breadth & 370 mm length and the other one is semi-circular with 105 mm radius and 370 mm length. The flat and panels are exposed to sunlight and multimeter is used to take power output values. The readings of voltage and current at output terminals are observed for two days and four times on each day at 10:00 am, 11:00 am, 1:00 pm and 3:00 pm. Voltage and current across output terminals of solar panels are taken and recorded and tabulated.

Volume: 09 Issue: 12 | Dec - 2025 SJIF Rating: 8.586 ISSN: 2582-3930

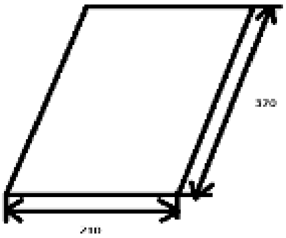

Fig. 1 Flat solar panel

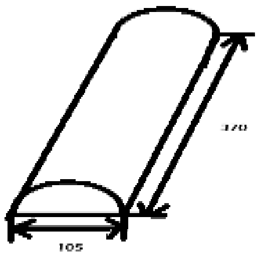

Fig. 2 Semicircular solar panel

3. RESULTS AND ANALYSIS

3.1 Readings across output terminals

Readings of voltage and current across terminals are collected at various day timings for flat and semicircular panels, and are tabulated. Readings are observed at 10 am, 11 am, 1 pm and 3 pm for two days.

Day 1 (2-9-25)
Flat solar panel readings:

Table 1. Day 1, flat panel outputs

Time	Voltage (mV)	Current (mA)
10 am	5.006	0.32
11 am	4.056	0.21
1 pm	3.133	0.20
3 pm	3.267	0.19

Semicircular panel readings:

Table 2. Day 1, semicircular panel outputs

Time	Voltage (mV)	Current (mA)
10 am	6.693	0.41
11 am	5.134	0.24
1 pm	4.023	0.33
3 pm	4.145	0.23

Day 2 (3-9-25)

Flat solar panel readings:

Table 3. Day 2, flat panel outputs

Time	Voltage (mV)	Current (mA)
10 am	3.145	0.19
11 am	4.323	0.31
1 pm	2.145	0.125
3 pm	2.124	0.025

Semi-circular solar panel readings:

Table 4. Day 2 Semicircular panel outputs

Time	Voltage (mV)	Current (mA)
10 am	3.576	0.240
11 am	5.342	0.390
1 pm	0.212	0.137
3 pm	3.135	0.035

3.2 Plots of voltage and current

Graphs are plotted by taking voltage or current values on y-axis and time on x-axis.

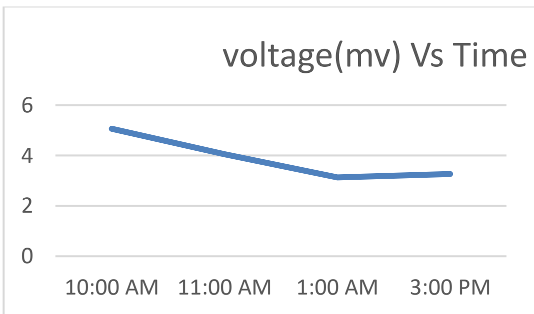

Fig.3 Day 1 voltage Vs time for flat plate

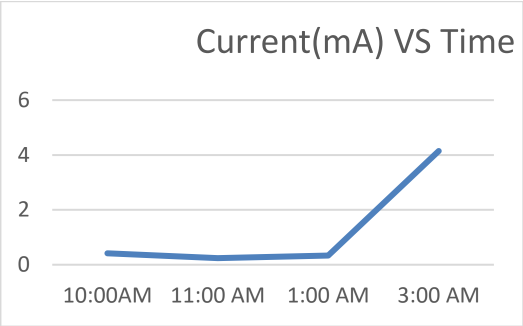

Fig.4 Day 1 Current Vs time for flat plate

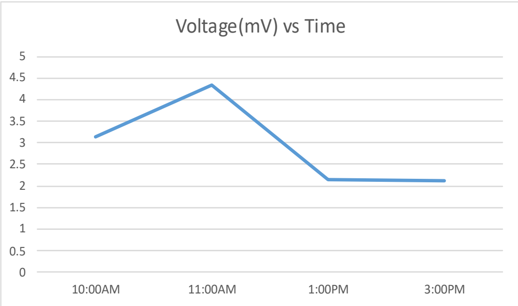

Fig.5 Day 1Voltage Vs time for semicircular panel

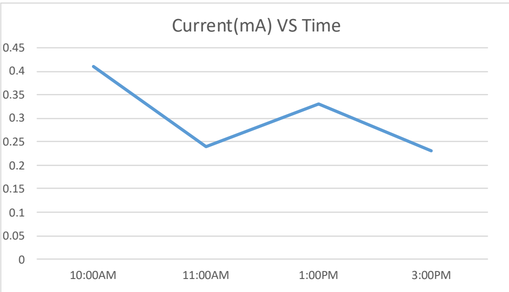

Fig. 6 Day 1 Current Vs time for semicircular panel

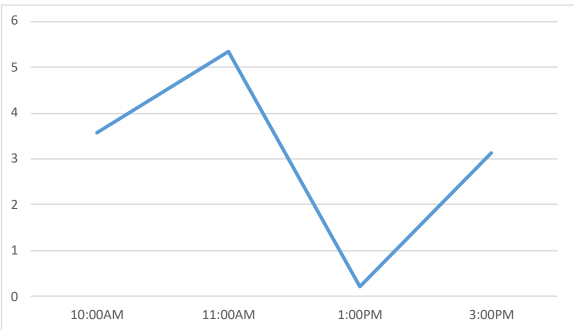

Fig. 7 Day 2 Voltage Vs time for flat panel

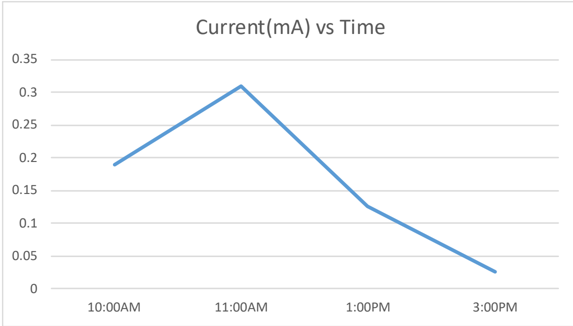

Fig. 8 Day 2 Current Vs time for flat panel

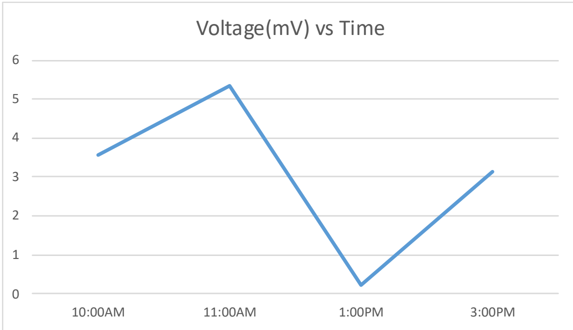

Fig. 9 Day 2 voltage Vs time for semicircular panel

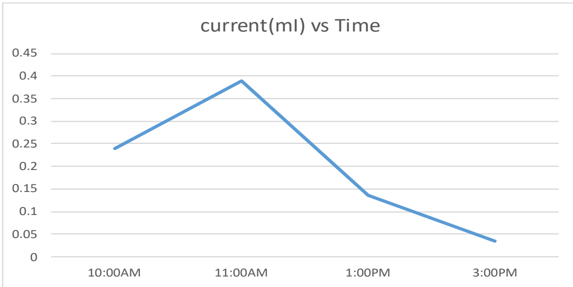

Fig. 10 Day 2 Current Vs time for semicircular panel

4. CONCLUSIONS:

Flat and semicircular panels are prepared to sizes of roof top household panels. After placing the above solar panels under sunlight current and voltage values across output terminals of panels are observed for two days and 4 different times on each day. Graphs are drawn between current, voltage on y-axis and time on x-axis. During cloudy time the current and voltage values are reduced compared to those of full sun shine time. It is observed that at all times and on both days the semicircular panel is giving higher output values compared to flat panels.

ACKNOWLEDGEMENT

We would like to thank Vignan's Institute of Engineering for Women, Visakhapatnam, India for supporting the research work.

REFERENCES

1. 1. Li, Xiaoyue & Li, Peicheng & Wu, Zhongbin & Luo, Deying & Yu, Hong-Yu & Lu, Zheng-Hong. (2020). Review and perspective of materials for flexible solar cells. Materials Reports: Energy. 1. 10.1016/j.matre.2020.09.001.
2. Low voltage rigid and flexible solar panels, Powersync energy solutions Rigid-and-Flexible-Solar-Panels.pdf
3. Maoz M, Abbas Z, Shah SAB, Lughi V. Recent Advances in Flexible Solar Cells; Materials, Fabrication, and Commercialization. *Sustainability*. 2025; 17(5):1820. https://doi.org/10.3390/su17051820
4. Pagliaro, Mario et al. "Flexible solar cells." *ChemSusChem* 1 11 (2008): 880-91 .
5. Groenewolt, Abel & Bakker, Jack & Hofer, Johannes & Nagy, Zoltán & Schlueter, Arno. (2016). Methods for modelling and analysis of bendable photovoltaic modules on irregularly curved surfaces. International Journal of Energy and Environmental Engineering. 7. 10.1007/s40095-016-0215-3.
6. Asare, Joseph, et al. "Deformation and Failure of Bendable Organic Solar Cells." Advanced Materials Research, vol. 1132, Trans Tech Publications, Ltd., Dec. 2015, pp. 116–124. Crossref, doi:10.4028/www.scientific.net/amr.1132.116
7. Koosha Nassiri Nazif, Alwin Daus, Jiho Hong, Nayeun Lee, Sam Vaziri, Aravindh Kumar, Frederick Nitta, Michelle Chen, Siavash Kananian, Raisul Islam, Kwan-Ho Kim, Jin-Hong Park, Ada Poon, Mark L. Brongersma, Eric Pop, Krishna C. Saraswat, High-Specific-Power Flexible Transition Metal Dichalcogenide Solar Cells, Nature communications, 12, 7034 (2021) https://arxiv.org/abs/2106.10609
8. Yinqing Sun, Faming Li, Flexible Perovskite/Silicon Monolithic Tandem Solar Cells Approaching 30% Efficiency, Nature Communications 2025 https://doi.org/10.1038/s41467-025-61081-w
9. Lirong Dong, Shudi Qiu, Fully printed flexible perovskite solar modules with improved energy alignment by tin oxide surface modification, Nature communications https://doi.org/10.48550/arXiv.2406.03123
10. Patel, H., Modi, K., Patel, R., & Patel, R. (2025). An experimental study on a curved solar flexible photovoltaic panel with a single-axis tracking system in perspectives of automobile applications. *International Journal of Ambient Energy*, *46*(1). https://doi.org/10.1080/01430750.2024.2444353
11. *J. Mater. Chem. A*, 2019,7, 3737-3744
12. Luke Richardson, What are solar panels made of and how are they made, Energy sage. What Are Solar Panels Made Of and How Are They Made? | EnergySage

BIOGRAPHIES (Optional not mandatory)

Mr. R. Aditya is Assistant Professor in department of Mechanical Engineering at Vignan's Institute of Engineering for Women, Visakhapatnam, India. He published many journals on advanced manufacturing, renewable energy sources and 3D printing.