UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DESIGN SOLAR PANEL: CONSIDERING AESTHETIC VALUE

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor's Degree in Manufacturing Engineering Technology (Product Design)(Hons.)

by

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ABSTRACT

Solar energy is one of the renewable energy that is very useful. It has been used by humans for thousands of years such as ancient cultures which used energy from sun to keep warm by starting fires with it. In the new age of technology, people are always thinking about how to enhance the technology by using renewable energy. Solar panels used to collect and utilize heat energy from sun. This paper proposed on how to consider the aesthetics value into solar panel design without interrupting the performance of the panel. This solar panel is design for guard house at UTeM Technology Campus which considering the aesthetic value, material usage, functionality, ease of attachment, assembly time, durability or strength, ease of manufacturing and ease of handling. The type of solar panel either it is suitable or not for guard house also should be considered. Hence, the development of this solar is to define either this project can give effectiveness or not and how the aesthetic solar panel can encourage people to invest for solar installation.

ABSTRAK

Tenaga Suria adalah salah satu tenaga yang sangat berguna. Ia telah digunakan oleh manusia untuk beribu-ribu tahun seperti budaya kuno yang digunakan tenaga daripada matahari untuk mengekalkan hangat dengan memulakan kebakaran. Dalam era baru teknologi, orang yang sentiasa berfikir tentang bagaimana untuk meningkatkan teknologi dengan menggunakan tenaga boleh diperbaharui. Panel solar yang digunakan untuk mengumpul dan menggunakan tenaga haba dari matahari. Kertas ini mencadangkan bagaimana untuk mempertimbangkan nilai estetika kedalam reka bentuk solar panel tanpa mengganggu prestasi panel. Panel solar ini adalah Reka bentuk untuk pos pengawal di kampus teknologi UTeM yang mengambil kira nilai estetik, penggunaan bahan, fungsi, kemudahan lampiran, masa perhimpunan, ketahanan atau kekuatan, memudahkan pembuatan dan memudahkan pengendalian. Jenis solar panel sama ada ia sesuai atau tidak untuk guard house juga perlu dipertimbangkan. Oleh itu, pembangunan ini solar adalah untuk menentukan sama ada projek ini boleh memberi keberkesanan atau tidak dan bagaimana panel solar estetik boleh menggalakkan orang lain untuk menggunakannya.

DECLARATION

I hereby, declared this report entitled "Design Solar Panel: Considering Aesthetic Value" is the results of my own research except as cited in references.

Signature : **…….**
Name : **YASMIN BINTI BISRAN**
Date : **18TH DECEMBER 2014**

APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering Technology (Product Design) (Hons.). The member of the supervisory is as follow:

……

(Project Supervisor)

DEDICATION

I dedicated my dissertation work to my beloved family and friends.

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First and foremost, I would like to take this opportunity to thank Puan Umi Hayati binti Ahmad, my supervisor for this project that is Design Solar Panel which Considering Aesthetic Value from Manufacturing Engineering Technology Department (JTKP) for giving me the space to grow intellectually by giving support, help, and advice throughout this semester to finish up my bachelor degree project 1 had been complete.

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CHAPTER 1
INTRODUCTION

This section is arranged in the following manner. Section 1.1 gives an overview of the project background while section 1.2 presents the problem statements of the project and section 1.3 presents the objective of the project and finally section 1.4 describes the scopes of the project.

1.1 Project Background

In ancient cultures, they have been used solar energy from thousands years to keep warm by starting fires with it. Besides that, they also kept their homes warm through passive solar energy designs because sun can heat their home and reduce its energy use. The most important is, the energy from sun can provide home feels comfortable years round. There are two types of solar design systems which is passive and active. Normally a homes that was constructed as passive solar design use natural movement of heat and air. This is because, to maintain comfortable temperatures, operating with little or no mechanical assistance and it takes advantage of local breezes and landscape features such as shade trees and windbreaks. It is also use a simplest system to collect and store solar energy with no switches or controls.

However, an active solar systems use a mechanical device to move heat from collectors to storage or from storage to use. Active solar systems also can be considered when photovoltaic panels collect solar energy and turning it into electricity.

In 1839, the discovery of photovoltaic happened when a French physicist Edmond Becquerel showed photovoltaic activity for the first time. He found that when the photon is exposed to light, the electrical current in certain materials can be increased. After 66 years, in 1905 Albert Einstein clearly describes the photoelectric effect whereas this principle is based on photovoltaic.

Solar or photovoltaic (PV) cells are known as an electronic device that essentially converts solar energy of sunlight to electrical energy or electricity. It does not store energy, but batteries can be used to store energy. There are a few types of PV which is monocrystalline, polycrystalline and amorphous silicon. An energy conversion of the sun's energy directly into electricity is a simple word to explain about PV cell. Along with advance in technology of PV systems, especially for safe source and clean energy sources, it comes with a several advantages:

i. PV cell produce power silently and does not have moving parts.

ii. Non-polluting with no detectable odours or emission.

iii. Can endure at severe weather conditions including snow and ice.

iv. Spent no fossil fuels which the fuel is free and abundant.

This project gives an overview about designing solar panel that considering aesthetic value without interrupting the performance of the panel. The overall objective of this project is to develop a new design of solar panel with an aesthetic value. Besides that, this project aims to analysed and improve the performance of solar panel with aesthetic value and after that, then it will be apply to the public places such as UTeM Technology Campus. The cost of solar panel remains an important non-technical barrier to this project, especially when applied as add-on to existing construction.

The project should be done within 33 weeks and is structured into two phases. At the first stage of this project, there was a research study about solar panel and any other project that related to solar panel. In a meantime, the design of the sketching of the solar panel also should be done. Once the

sketching has been established, the project will entered into a method selection to mounting the solar panel.

1.2 Problem Statement

Aesthetics is a branch of philosophy dealing with the nature of art, beauty, and taste, with the creation and appreciation of beauty. Since this project will implemented with the aesthetics value, there have some criteria will be considered. Firstly, the type of solar panel which to be applied will provide the best performance. The next criterion is the surface texturing of the solar panel on the colour-matched of silicon and area of roof-mount. Lastly, the design of the solar panel also should attractive and beautiful; the location to install the solar panel is considered as criteria.

1.3 Objectives

There are three objectives that need to be achieved by conducting this project which are:-

(a) To design solar panel considering aesthetic value.

(b) To design solar panel without interrupting the performance of solar panel.

(c) To educate public people about the importance and benefit of green technology.

1.4 Scope

The general scopes of this project that need to be focused are:-

(a) Design solar for UTeM Technology Campus post guard

(b) Identify the performance of the solar panel

(c) The position of solar panel at the post guard

Figure 1.1:Location to place the solar panel

CHAPTER 2
LITERATURE REVIEW

This section is arranged in the following manner. Section 2.1 describes about solar panel design, section 2.2 presents the type of solar panel, section 2.3 describes about size of solar panel, and the last section 2.4 describe the manufacturing of solar panels.

2.1 Solar Panel

In 19th century, there are a phenomenon discovered where a solar panel was generate an electricity using the photovoltaic effect. This phenomenon was found by a scientist who observed that certain materials produced an electric current when exposed to light(Boxwell, 2012). Solar electricity could be a wonderful concept where it can take power from the sun to generate power to electrical equipment.

Figure 2.1: Application of solar panel

Photovoltaic or PV in short, is defined as a technology which converted light sources into electrical power and recently known as solar power [1]. There are several ways to generate this energy but the best way is by using solar cells packaged in a PV module. PV modules are the basic element of each PV system that is consists of many jointly connected solar cells. By manufacturing modules which contain dozens of solar cells that connected together, a large energy can be generated by the solar panel. The major problem with solar power is the technology of solar panel. The efficiency of solar power system still poor compare to other sources. There are several factors that affect the efficiency of this system which is solar cell efficiency, intensity of source radiation and storage technique. The output power has to be maximized in order to increase the efficiency instead of the aesthetic value in design of solar panel. Hence, one of the method on improving the efficiency and power output of solar power collection is to increase the mean intensity of radiation received from the source (Mohamad Fazman Bin Mohamad Yunus(2009). "*Design and Development of Solar Tracking*", UniversitiTeknologi Malaysia.)

2.2 Type of Solar Panels

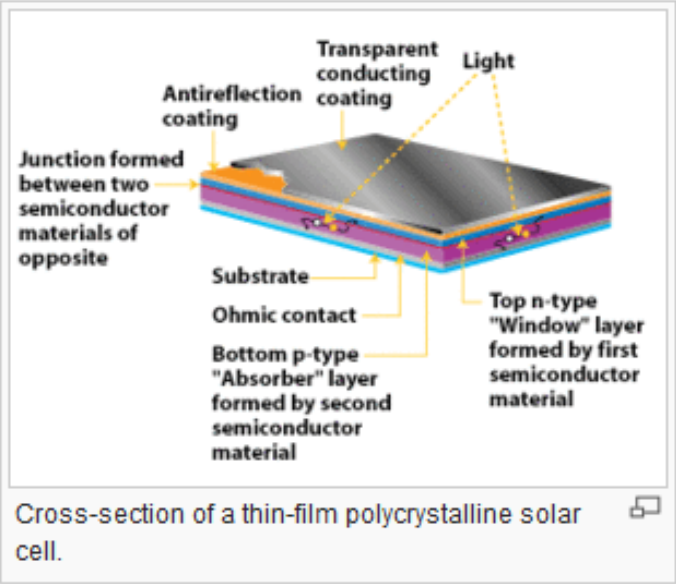
Recently, there are many types of solar panel that can be found in the market. Solar panels require a light absorbing material contain within the cell structure to absorb photons and generate electrons via photovoltaic effect. Light absorbing materials mostly used in multiple physical configurations to take advantage of different light absorption and charge separation mechanisms. According to Dr. Peter Gevorkian, 2006, he said in his book which is Sustainable Energy in Architectural Design, there are three main types of solar panels which is monocrystalline, polycrystalline and thin film. Monocrystalline use a single silicon crystal which about 60 cells per panel. The most efficient is monocrystalline that is up to 20% and it does not require a lot of space. But, it is the most expensive and it is suitable for low light condition.

Figure 2.2: Monocrystalline solar panels

However, polycrystalline panels which are also known as multicrystalline. This kind of panels made from silicon offcuts, molded to form blocks and create a cell that made up of several bits of pure crystal. The appearance of this type of solar panel was looks like random crystal arrangement and the panels look a little bluer as they reflect some of the light and for the cost is quite similar to monocrystalline.

Figure 2.3:Polycrystalline solar panel

As for thin films cells, it was made by thin layers of photovoltaic material which deposited on a glass that is created by vapor deposition. Even though it has the lowest efficiency and require a lot of space, but it is also the cheapest and the performance increase when the temperature increase.



Cross-section of a thin-film polycrystalline solar cell.

Figure 2.4: The cross-section of a thin-film polycrystalline solar cell.

According to Malaysian Meteorological Department, since Malaysia was located near the equator where the solar radiation is high throughout the year, so, it is suitable to be used a thin film solar panel in Malaysia. Even though the temperature is high, but sometimes Malaysia have a cloudy and rainy days. To solve this problem, a thin film is not affected at all. On the other hand, the performance of monocrystalline can drop up to 80% even there is slightly of shading.

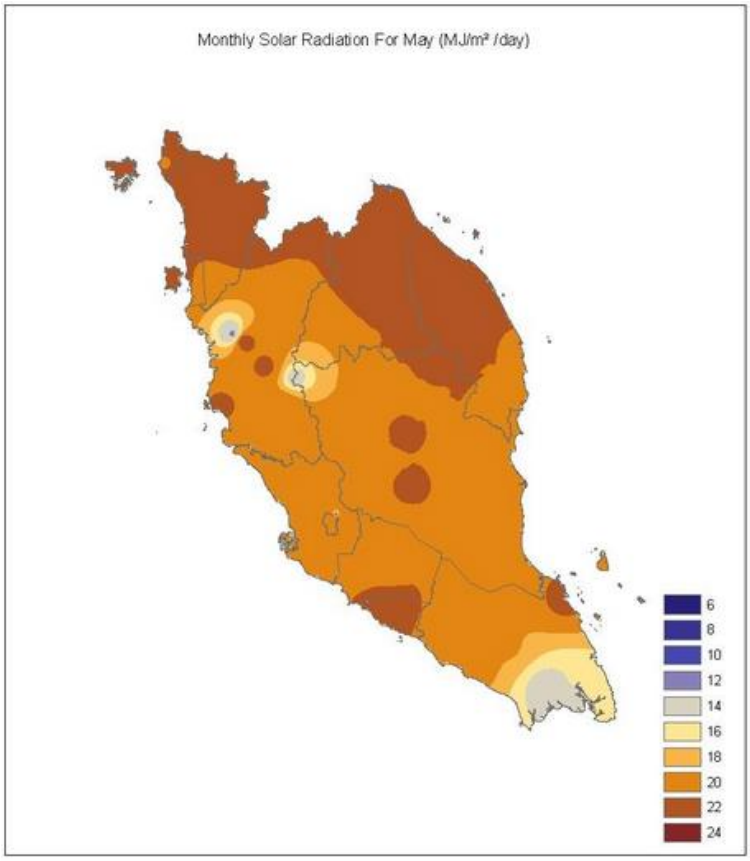


Figure 2.5: Solar radiation map of Malaysia in Peninsula Malaysia

Colors also can be one of the criteria for the election of solar panel. The color appearance in solar panel is highly desirable for fabricating aesthetics solar panels in building integration or camouflaged solar cells for remote powering of field instruments (Nader M. Kalkhoran and Patrick F. Murphy, 2000). Besides that, a uniform or a variable color pattern on each wafer as desired can be approached.

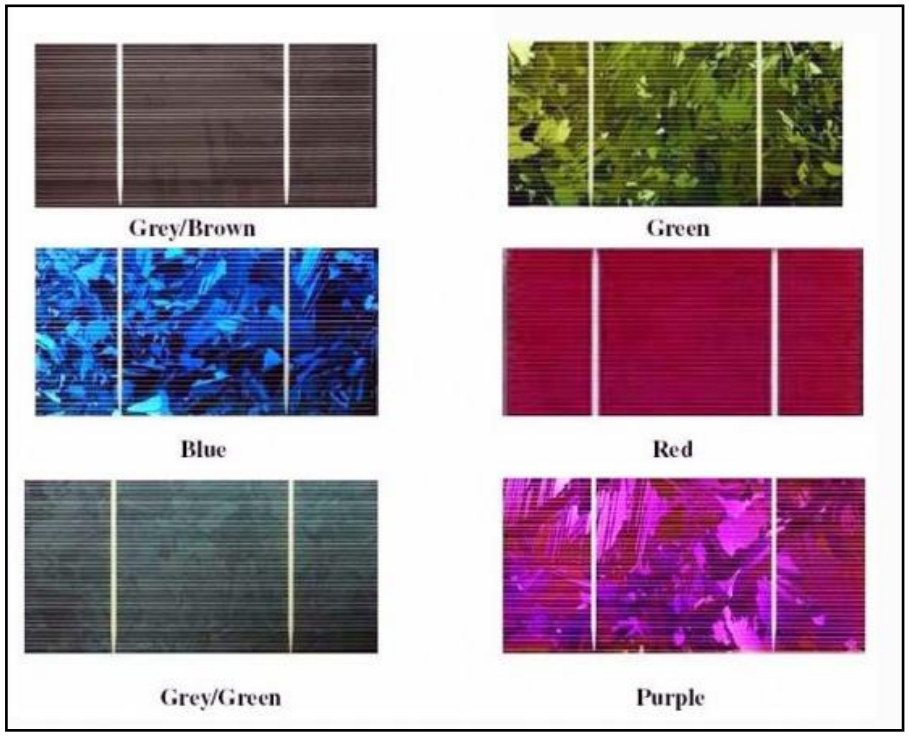


Figure 2.6:Variation color of solar panels

Metal curtain wall was integrated by designing PV module to realize building integration of photovoltaic. They were installed as spandrel panels and consist of long and slender PV sub modules. By using this wall, almost same maximum P_{max} of 64 W/m^2 was obtained and the module temperature approximately 10°C lower compared with conventional superstrate-type PV modules that only have 1.3 times the solar cells of the modules. Besides that, they also discussed about the aesthetic requirements for the module in this paper, (Photovoltaic Modules Integrated with A Metal Curtain Wall, 1994). Based on this research, it is very similar to the research done for this project. To design a solar panel, not only the aesthetics value can influence the performance, but the types of solar panels used also should be considered.

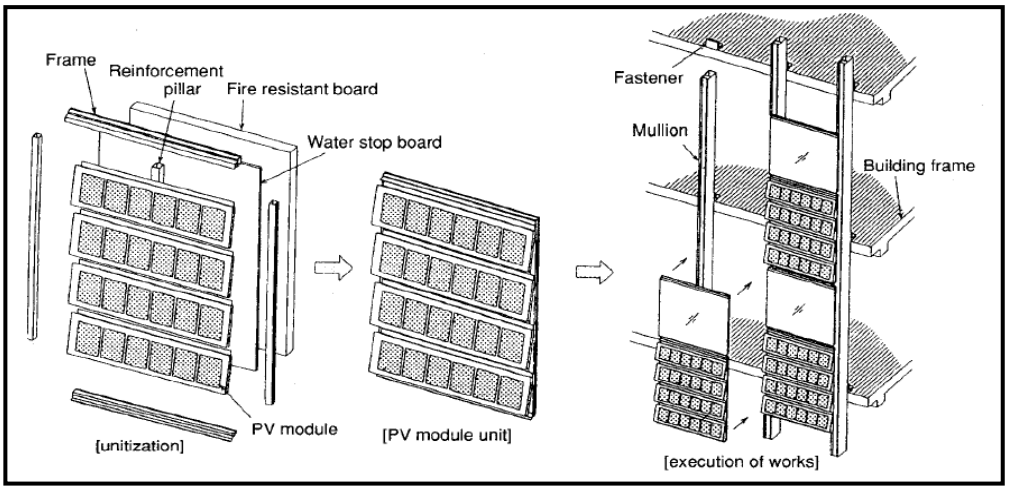


Figure 2.7: Photovoltaic module unit and its principles of construction.

In addition, there are also some other choices to produce a solar panel either the solar PV must be on-grid or off-grid. S. S. S. Ranjit, C.F. Tan and S. K. Subramaniam (2011) pointed that by using the calculation that has been carried out, they can determine the system size and design of solar panel, hence can show the improving the system design. Besides that, their system set-up also could be operating in automatic mode to switch on at night and off the system during the day light. Off-grid solar system is a completely independent from grid and it has capability to provide power system in a remote location. Meanwhile, grid-tie solar system is happen when electricity generated by solar panels and fed into grid during peak production. Besides that, it does not require battery because the grid acts as battery. Table below shows the advantage and disadvantage for off-grid and on-grid of solar system.