Faculty of Manufacturing Engineering

ANALYSIS ON THE PERFORMANCE OF BLADE DESIGN FOR WIND TURBINE SYSTEM FROM AN AIR CONDITIONER WASTE

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Master of Manufacturing System Engineering

2018

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ANALYSIS ON THE PERFORMANCE OF THE BLADE DESIGN FOR THE WIND TURBINE SYSTEM FROM AN AIR CONDITIONER SYSTEM.

NUR ANIS SURAYA BINTI SALIM

A thesis submitted
in fulfillment of the requirements for the Master of Manufacturing Engineering System

Faculty of Manufacturing Engineering

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2018

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DECLARATION

I declare that this thesis entitled “Analysis on the performance of the blade design for the Wind Turbine system from an air conditioner waste” is the result of my own research except as cited in the references. The thesis has not been accepted for any master and is not concurrently submitted in candidature of any other master.

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APPROVAL

I hereby declare that I have read this dissertation/report and in my opinion this dissertation/report is sufficient in terms of scope and quality as a partial fulfillment of Master of Manufacturing Engineering (System).

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DEDICATION

To my beloved mother and father

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ABSTRACT

Nowadays, the global energy consumption is increased rapidly especially in the developing countries. This is due to the high of the population and economic growth that lead to higher demands of the energy that only can make it in a critical situation. Thus, it has to be conserved in good ways so that these non-renewable energy sources would not be depleted in the future. The idea of using the renewable energy technology is steadily increased for the past few years in order to meet the requirement of the energy demands. The renewable energy has a very impressive potential of resources that is very useful in cost reduction of natural costs that connected to the customary energy supply system to make it as the option energy source, later on, to be used. Thus, the aim of this project is to analyze the performance of the blade design of wind turbine system from air conditioner waste. This can decrease the wasted air that been discharged freely to environment without further action. The blades from previous work of the wind turbine mechanism is been applied throughout this project.

Hence, three blades design which are National Renewable Energy Laboratory (NREL) modern wind turbine blade design, elliptical blade and swept blade are chosen for performance analysis. These blades is designed by using SOLIDWORKS software as well as simulation of the wind flow on the blades also will be conducted. Yet, selection of the best blade design is cannot totally based on the simulations

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performance analyses, comparison between wind turbine blade design requirements are needed such as aspect ratio and blade twist. Last but not least, to compare and identify correlation the overall best performance for three types of blades with the experimental test from previous work. And the results shows that the higher ratio in comparison pair wise of design concept 3 in criteria of Controllability, Material and Position of wing system is the main reason that design concept 3 is selected based on the result of AHP method.

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ABSTRAK

Pada masa kini, penggunaan tenaga global meningkat dengan pesat terutama di negara-negara membangun. Ini disebabkan oleh bilangan penduduk dan pertumbuhan ekonomi yang membawa kepada tuntutan tenaga yang lebih tinggi yang hanya boleh membuatnya dalam keadaan kritikal. Oleh itu, ia perlu dipelihara dengan cara yang baik supaya sumber tenaga yang tidak boleh diperbaharui ini tidak akan habis pada masa akan datang. Idea menggunakan teknologi tenaga boleh diperbaharui semakin meningkat sejak beberapa tahun yang lalu untuk memenuhi keperluan permintaan tenaga. Tenaga boleh diperbaharui mempunyai potensi sumber daya yang sangat mengagumkan yang sangat berguna dalam pengurangan kos kos semulajadi yang berkaitan dengan sistem bekalan tenaga adat untuk menjadikannya sebagai sumber tenaga pilihan, kemudian digunakan. Oleh itu, matlamat projek ini adalah untuk menganalisis prestasi reka bentuk bilah sistem turbin angin dari sisa penghawa dingin. Ini dapat mengurangkan udara terbuang yang telah dilepaskan bebas ke alam sekitar tanpa tindakan selanjutnya. Bilah-bilah dari kerja mekanik turbin angin sebelumnya telah digunakan sepanjang projek ini.

Oleh itu, reka bentuk tiga bilah yang merupakan Reka bentuk bilah turbin angin moden Makmal Tenaga Boleh Diperbaharui (NREL), bilah elliptical dan bilah swept akan dipilih untuk analisis prestasi. Reka bentuk bilah ini akan direka bentuk dengan menggunakan perisian SOLIDWORKS serta simulasi aliran angin pada bilah juga akan dijalankan. Walau bagaimanapun, pemilihan reka bentuk bilah yang terbaik tidak boleh

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sepenuhnya berdasarkan analisis prestasi simulasi, perbandingan antara keperluan reka bentuk bilah turbin angin diperlukan seperti nisbah aspek dan sentuhan bilah. Akhir sekali, untuk membandingkan dan mengenal pasti korelasi prestasi terbaik keseluruhan untuk tiga jenis bilah dengan ujian eksperimen dari kerja sebelumnya.

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ACKNOWLEDGEMENTS

First and foremost, I would like to take this opportunity to express my sincere acknowledgement to my supervisor Dr. Fairul Azni Bin Jafar from the Faculty of Manufacturing Engineering Universiti Teknikal Malaysia Melaka (UTeM) for his essential supervision, support and encouragement towards the completion of this thesis. Besides that, i would like to dedicated this special thank to my late mother, father and familys for this opportunity, love and support throughout my journey to complete this thesis.

Then, I would also like to express my deepest gratitude to Mr. Goh Jee Boon, my senior from mechatronic laboratory Faculty of Manufacturing Engineering for his assistance and efforts in all the lab and analysis works. Moreover, I would like to thank to all my peers, especially Mr. Amirul Hakim for their moral support in completing this thesis. And last but not least, I would like to thank you to everyone who had been to the crucial parts of realization of this project

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CHAPTER 1

INTRODUCTION

Generally, this chapter is focused on the purpose of the project. Firstly the problem statements, is translated from the current issues. Then to overcome the problem statement, the objectives of the project are established. And lastly, the project scope will enlarge on all the scope and the limitation of the project.

1.1 Background

A process of regenerate or recover the waste air into wind energy is known as Waste Kinematic Energy Recovery System (WKERS). Therefore, the wind turbine is needed as a mechanism to regenerate or recover the discharged air to the environment. Nowadays, the global energy consumption is increased rapidly especially in the developing countries. This is due to the high of the population and economic growth that lead to higher demands of the energy that only can make it in a critical situation. Thus, it has to be conserved in good ways so that these non-renewable energy sources would not be depleted in the future. The idea of using the renewable energy technology is steadily increased for the past few years in order to meet the requirement of the energy demands.

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The renewable energy has a very impressive potential of resources that is very useful in cost reduction of natural costs that connected to the customary energy supply system to make it as the option energy source, later on, to be used. The usage of this energy sources is better in performance and economic aspect. Furthermore, it is not limited but is highly depend on the geographical conditions. The places that the most energy is needed are in the urban areas such as in industrial and residential sectors. This is because of the electricity usage of that equipment such as a lamp, fans, air conditioner, freezer and etc, is very high. However, in this project, in order to generate the electricity from the alternatives wind resources, is by using the wind turbine systems. Besides that, the turbines are encompassed by fenced in areas to enhance the performance as well as the wind stream of the ventilation system. The electricity that been generated from this system can be utilized to power up the power consumption of the small home appliances such as lamps, fans, and electrical appliances.

1.2 Motivation of the Study

In this modern era, the higher usage of the non-renewable energies such as fossil fuels, natural gas and much more causing the energies to decrease rapidly due to the high demand of population especially in the city and industrial areas. Thus to avoid the energies continue to decrease dramatically, the alternative method is by using the renewable energy such as solar, the wind, bio and also geothermal energy. This research has been done by many researchers before, in order to find another source which can be used as the energy to produce electricity. Therefore, one of the sources that can be considered is the wasted discharged air from the compressor of air conditioning system.

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Previously, this wasted air is only being discharged to the atmosphere without further process intake. Hence, just like using the concept of the wind energy, the waste air can be valued in the form of energy, and can be reused as energy to generate and producing the electricity. Rather than being removed as waste to the atmosphere, reused this energy to form the wind energy is another method to produce energy. This alternatives method is able to reduce the electricity usage of the household and also save the budget of the electricity. Besides that, what more that motivate to the study is the application that uses the wind energy or kinetic energy as their source.

According to historical, many people that used and apply the concept of the wind turbine to refrigerate new fish for conveyance to adjacent markets. In addition, the wind turbine has also been used for pumping of water. The applications for small wind turbines are constrained just by the creative thinking and ability of the person. Moreover, what is attracted and motivated in doing the study is using the SolidWorks software to design the prototype.

Then, there also have the mechanical and electrical part that need to be done in this project in order to obtain the desired performance of the prototype. The mechanical part needs to fabricate the prototype by using the 3D printer. Hence, got to gain knowledge on how to used and conduct the printer is such a good experience. Meanwhile, for the electrical part that needs to build the simple electric circuit in order to connect the prototype to the small home appliances which are a lamp.

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Lastly, the motivation of the study is to develop the application that used the energy from the regenerative system for home appliances such as a lamp, fan and much more. This application can save nature and reduced from unnecessary gas that been released without further action mostly in the industrial sector and city areas.

1.3 Problem Statement

The idea of recovering the wasted air from ventilation of air conditioning system has been completed by researchers. However, various issues are confronted amid during the research. For examples, due to many building that used the air conditioning system, the wasted air has been discharged through the ventilation of system of the air conditioner. The wasted air is been discharged freely to the atmosphere without further action be taken. As what can be seen, the wasted air which is known as kinetic energy or wind energy can regenerate or reuse back in the form of electrical energy. In addition, the usage of the air conditioning system can increase the monthly electricity expenses for the household unit. This can be seen, when a house that used air conditioning system regularly or keeps using in a prolonged period of time, the power consumption that needs to operate in the electrical devices may lead to high energy usage that drags the reading of electric tariff. Thus, the monthly expenses of the household will be increased. Hence, this situation should be improved in order to reduce the electricity expenses.

Moreover, vibration occurred on the wind turbine when it was working. The occurrence of this vibration may because of the structure of the wind turbine was insufficient to withstand the wind energy from the fan and this prompt to the harm of the machine.

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Also, the removal of tidy for the fan must be done after each experimental test. Tidy gathered on the blades once it was working and this influenced the performance of the fan and analyzed the result. Additionally, the performance of the wind turbine was influenced when the focal point of the fan did not parallel to the origin of the wind turbine.

Next, a tap was required on the blade to turn the rotor of the wind turbine when it achieved a specific approach to the wind. This happens because of an electric current which goes through a loop in an attractive field of the DC Dynamo generator does not have insufficient to deliver a torque with the attractive constrain. Thus, the engine cannot turn until a tap is connected to the blades.

Therefore, an alternative method needs to be taken in order to solve the problems, in which the wasted air should regenerate electricity, and the electricity can be used in the development of energy regenerative system for home appliance application such as lamps in order to reduce the usage of electricity of the household and also choosing a good material for wind turbine prototype, and lastly the good blade design from previous research.

1.4 Research Questions

There are several question when this research study starts such as:

i. What criteria is needed to simulate the design of the blade in order to enhance the performance of the blade?

ii. How to ensure that the simulation result is better than the actual test?

iii. Which design of the blade should be selected at the end of this research study?

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1.5 Aim and Objectives

The aim this study is to compare the performance analysis of the three different type of the blades of wind turbine for energy regenerative system from an air conditioner waste.

There are three objectives of this study which are:

i. To design the type of the Wind Turbine blades of Waste Kinetic Energy Recovery System (WKERS) in the engineering drawing format for all the blades.

ii. To identify and analyze the selection of the parameters to be used in the blades design by using Analytical Hierarchy Process (AHP).

iii. To identify the design concept of the selected blade by using SolidWorks Simulation based on the selected parameter.

1.6 Research Scope

The scope and limitation of this project are:

i. Three types of blade design chosen.

ii. The design is performed by using SolidWorks design and simulation software.

iii. Parameters considered are based on AHP methods for blade design.

iv. Analysis is to be done through simulation considering the going to be selected important parameters.

v. Only simulation analysis will be carried out and no experimental analysis will be done.

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