UNIVERSITI TEKNIKAL MALAYSIA MELAKA

PERFORMANCE ANALYSIS OF DIFFERENT BLADE DESIGN FOR WASTE KINEMATIC ENERGY RECOVERY SYSTEM (WKERS)

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering (Robotics & Automation) with Honours

By

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I hereby, declared this report entitled “Performance Analysis of Different Blade Design for Waste Kinematic Energy Recovery System (WKERS)” is the results of my own research except as cited in references.

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APPROVAL

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

……

(Dr. Fairul Azni bin Jafar)

ABSTRAK

Waste Kinematic Energy Recovery System (WKERS) adalah satu sistem menjana semula udara dalaman dan dilepaskan ke atmosfera oleh kipas pengudaraan melalui sistem pengudaraan ke dalam satu bentuk tenaga angin. Sebuah turbin angin akan dibina untuk menjana tenaga elektrik dengan udara dalaman sesebuah bangunan. Terdapat projek yang sama yang telah dijalankan oleh penyelidik. Namun, beberapa masalah masih berlaku semasa peringkat pembangunan seperti prestasi bilah turbin angin. Dalam kajian sebelum ini, reka bentuk delta sayap digunakan sebagai reka bentuk bilah turbin angin tetapi prestasi tidak dioptimumkan. Oleh itu, tiga bilah reka bentuk yang boleh diperbaharui National Laboratory Tenaga (NREL) turbin angin Reka bentuk bilah moden, bilah elips dan melanda bilah akan dipilih untuk analisis prestasi. Bilah ini akan direka dengan menggunakan perisian SOLIDWORKS serta simulasi aliran angin pada bilah juga akan dijalankan. Dua jenis simulasi adalah aliran linear dan berputar dilakukan untuk menganalisis aliran udara melalui kipas. Namun, pemilihan reka bentuk bilah yang terbaik tidak boleh sama sekali berdasarkan simulasi prestasi analisis, perbandingan antara keperluan reka bentuk bilah turbin angin yang dimestikan seperti nisbah aspek dan bilah twist. Akhir sekali, reka bentuk bilah NREL mempunyai prestasi keseluruhan terbaik dalam reka bentuk bilah turbin angin daripada reka bentuk bilah elips dan melanda.

ABSTRACT

Waste Kinematic Energy Recovery System (WKERS) is a system of regenerating waste or used air which is released to the atmosphere by a ventilation fan through ventilation system into a form of wind energy. A wind turbine will be developed to produce electricity by generating the waste air. There is a similar project which has been developed by a researcher. Yet, several problems still occur during the development stage such as the performance of the wind turbine blades. In previous research, a delta wing design is being used as the wind turbine blade design but the performance is not optimised. Hence, the objective of this project is selecting a best blade design to replace the previous delta design. Three blades design which are National Renewable Energy Laboratory (NREL) modern wind turbine blade design, elliptical blade and swept blade will be chosen for performance analysis. These blades design will be designed by using SOLIDWORKS software as well as simulation of the wind flow on the blades also will be conducted. Two types of simulation which are Linear and rotating flow simulation are done to analyse the airflows passes through the propeller. Yet, selection of the best blade design is cannot totally based on the simulations performance analyses, comparison between wind turbine blade design requirements are needed such as aspect ratio and blade twist. Last but not least, NREL blade design has the overall best performance in wind turbine blade design than elliptical and swept blade designs.

DEDICATION

For my beloved family, final year project supervisor, master supervisors, lecturers and friends that always believe in me to complete this project and report.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURES

WKERS	-	Waste Kinematic Energy Recovery System
HVAC	-	Heating, Ventilating, and Air Conditioning System
DC	-	Direct Current
FTMK	-	Fakulti Teknologi Maklumat dan Komunikasi
CNC	-	Computer Numerical Control
VAWT	-	Vertical Axis Wind Turbine
HAWT	-	Horizontal Axis Wind Turbine
PSM	-	Projek Saujana Muda
NREL	-	National Renewable Energy Laboratory
NASA	-	National Aeronautics and Space Administration
MMGS	-	Millimetre, Gram and Second
3D	-	3 Dimensions
NACA	-	National Advisory Committee for Aeronautics
MAC	-	Mean Aerodynamic Chord

AOA	-	Angle of Attack
CFD	-	Computational Fluid Dynamics
m/s	-	Meter Per Second
mm	-	millimeter
m	-	Meter
Pa	-	Pascal
ROI	-	Return on Investment

CHAPTER 1
INTRODUCTION

Chapter 1 will discuss the background of the study, related problem statements, objectives of the study, scope or limitation of the project Background of the study will be focused on the characteristics and functions of Ventilation Fans. Next, the problem statements will enlarge the hidden circumstances of the air produced by the Ventilation Fans while the objective of this project is to design a wind turbine for utilise the air produced by the Ventilation Fans. Last but not least, the scope or limitation will highlight the project scope and the limitation of the study.

1.1 Background

Waste Kinematic Energy Recovery System (WKERS) is a process of regenerate or recovery the waste air into wind energy. Therefore, a ventilation fan is needed as a mechanism to eliminate the waste air to the environment. Before explaining the characteristics and functions of the Ventilation Fans, an idea about ventilation is needed. Ventilation is a 'V' in Heating, Ventilating, and Air Conditioning System (HVAC). HVAC is a technology of indoor and vehicular environmental comfort. These three functions of HVAC system are closely interrelated in providing thermal

comfort and well indoor air quality. It provides heating through heating system, filtration, oxygen, comfort and building pressure control through ventilation system while cooling and humidity control through air conditioning system. Typically, HVAC system is applied in several places and areas such as cars, buildings, houses, industries and so on.

What is the meaning of ventilation? It is a process of purifying and replacing the unhealthy air into healthy air in a building, housing, industry or any space to provide a high indoor quality. A high indoor quality involves controlling indoor temperature, replenishing fresh air and eliminating dust, odours, moisture, heat, smoke, carbon dioxide and airborne. It includes in exchanging of air with the outside and also air circulation within the building.

Why is ventilation significant? It is important as ventilation means fresh air. Maintaining a fresh air supply in house and especially in industrial areas are vital for keeping family and workers healthy. Good ventilation keeps family and workers away from irritating pollutants, unpleasant odours and harmful gases such as carbon monoxide. In an industry, well ventilation system is very essential. For example, the environment of a glove industry is hot, uncomfortable, moisture, high humidity, and pungent smell due to dangerous gases like chlorine and latex. If the ventilation system in the glove industry is bad, workers and operators will have a high risk to have health problems like lung cancer, respiratory problems, eye sore, dehydration due to hot and stuffy environment and so on. According to Hughes et al. (2007), the supply of fresh air should not normally fall below five to eight litres per second per occupant. Therefore, an alternative way is needed to overcome the bad ventilation of industries, buildings, rooms and so on.

What is the alternative method? In order to solve this problem, ventilation fan is then invented. A ventilation fan is a mechanism device installed on the roof or on the wall in industries and it is typically used to define as a fan that is used to ventilate and exclude contaminated, harmful and hot air away from the building, housing, industry and replace with fresh air to provide good indoor condition air quality. The main function of the ventilation fans are freshening by excluding polluted indoor air, maintaining fresh air and providing a better breathing for people and decreasing carbon dioxide in the industries by increasing oxygen.