FEASIBILITY STUDY OF WIND TURBINE AT HIGHWAY FOR POWERING STREETS LIGHTING

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This report is submitted
in partial fulfillment of the requirement for the degree of
Bachelor of Mechanical Engineering

Faculty of Mechanical Engineering

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2022

DECLARATION

I declare that this report entitled “Feasibility Study of Wind Turbine at Highway for Powering Streets Lighting” is the result of my own work except as cited in the reference.

Signature : .....

Name : .....

Date : .....

APPROVAL

I hereby declare that I have read this project report and in my opinion this report is sufficient in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering.

Signature :.....

Name of Supervisor : .....

Date :.....

DEDICATION

My thesis is dedicated to my beloved family as well as my friends. My grateful parents, Amiruddin Bin Mohammad and Maheran Binti Ismail, deserve special recognition. Their words of encouragements and motivations to persevere are still playing in my head. My siblings and friends have never forgotten for me and are truly remarkable.

ABSTRACT

Wind energy is a new future renewable energy source that has been introduced to the world in order to protect the environment in the long run. Wind turbines can be utilized to increase the turbulence produced by wind energy in roadways. This project will investigate the feasibility of using wind turbines to power street lighting on Malaysian roadways. To undertake this feasibility study, certain parameters will be chosen. This shows the design and fabrication of a vertical axis wind turbine model as well as a model of three different types of vehicles. The SPA and AMJ highways in Melaka, Malaysia, will be the principal area for collecting wind measurement data utilizing an anemometer at a specified height from the ground. It will then be employed as testing parameters for the movement of three different vehicle models as well as a portable table fan wind speed reference. The voltage and current output data will then be gathered and measured with a multimeter. The variations in data output between helical and curve blade types, as well as the state of the wind turbine model with and without barrier mechanism, will be compared. This wind turbine model's graphical output will demonstrate the viability of employing this actual wind turbine model to power street lighting on Malaysia highways. A number of suggestions and enhancements have also been made in order to assist future research on the feasibility of using wind turbines in Malaysia.

ABSTRAK

Tenaga angin ialah sumber tenaga boleh diperbaharui masa hadapan baharu yang telah diperkenalkan kepada dunia untuk melindungi alam sekitar dalam jangka masa panjang. Turbin angin boleh digunakan untuk meningkatkan pergolakan yang dihasilkan oleh tenaga angin di jalan raya. Projek ini akan menyiasat kemungkinan menggunakan turbin angin untuk menyalakan lampu jalan di jalan raya Malaysia. Untuk menjalankan kajian kebolehlaksanaan ini, parameter tertentu akan dipilih. Ini menunjukkan reka bentuk dan fabrikasi model turbin angin paksi menegak serta model tiga jenis kenderaan berbeza. Lebuh raya SPA dan AMJ di Melaka, Malaysia, akan menjadi kawasan utama untuk mengumpul data pengukuran angin menggunakan anemometer pada ketinggian tertentu dari tanah. Ia kemudiannya akan digunakan sebagai parameter ujian untuk pergerakan tiga model kenderaan berbeza serta rujukan kelajuan angin kipas meja mudah alih. Data keluaran voltan dan arus kemudiannya akan dikumpulkan dan diukur dengan multimeter. Variasi dalam output data antara jenis bilah heliks dan lengkung, serta keadaan model turbin angin dengan dan tanpa mekanisme penghalang, akan dibandingkan. Output grafik model turbin angin ini akan menunjukkan daya maju menggunakan model turbin angin sebenar ini untuk menyalakan lampu jalan di lebuh raya Malaysia. Beberapa cadangan dan penambahbaikan juga telah dibuat untuk membantu penyelidikan masa depan tentang kebolehlaksanaan penggunaan turbin angin di Malaysia.

ACKNOWLEDGEMENT

First and foremost, I'd would want express my gratitude and appreciation to my supervisor, Dr. Shamsul Anuar Bin Shamsudin from Faculty of Mechanical Engineering, (UTeM) for providing me with guidance and encouragements in completing this project successfully. Not to forget, Dr. Reduan Bin Mat Dan which also from FKM, UTeM, my prior supervisor during PSM 1, for his early sharing of ideas and information with me in order for me to understand more about Wind Turbine Technology.

Also, I'd like to thank Mr. Kamil Anuar bin Akram @ Jummah and Mr. Habirafidi bin Ramly for providing me permission to use the welding workshops and the Integrated Design Project Laboratory (IDP). Both of them not only permit me to utilize the lab, but also assist and coach me in using suitable fabrication equipment techniques. Mr. Kamil was quite helpful in teaching me how to use a CNC Plasma machine cutter. Mr. Habirafidi, on the other hand, has greatly aided in the TIG welding of aluminum components. Even if faults and errors arise throughout the fabrication process, they would like to brainstorm ideas with me in order to provide the best solution for the issues that occurred.

Apart from that, I'd want to convey my gratefulness to Afiq Taqiuddin and my other fellow friends for accompanying me in performing this experiment by building confidence and useful suggestions for difficulties that I was having.

Last but not least, I'd really like to show my thankfulness to all of my friends who were directly and indirectly participating, as well as my dear father and mother, relatives, and educators, for providing me with self-motivation and excellent care and support in completing my degree. Finally, I intended to extend my thanks to everyone who contributed to the successful completion of this project.

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LIST OF ABBREVIATIONS

VAWT	=	Vertical Axis Wind Turbine
HAWT	=	Horizontal Axis Wind Turbine
SWT	=	Small Wind Turbine
FiT	=	Feed in Tarif System
HVAWT	=	Horizontal Vertical Axis Wind Turbine
DC	=	Direct Current Generator
MPV	=	Multi-Purpose Vehicles
FKM	=	Fakulti Kejuruteraan Mekanikal
UTeM	=	Universiti Teknikal Malaysia Melaka

LIST OF SYMBOLS

C_D	=	Drag Coefficient
C_L	=	Lift Coefficient
P	=	Power
V	=	Voltage
I	=	Current
v	=	Velocity
ρ	=	Density
A	=	Cross-sectional Area/ Swept Area
D_r	=	Diameter of the rotor
H_r	=	Height of rotor

CHAPTER 1

INTRODUCTION

1.0 Project Background

Prof James Blyth of Anderson's College came up with the concept of building the firstwind turbine that could produce electricity in July 1887. Then, Blyth's proceed the idea to buildthe first wind power in his garden to power the lighting at the cottage and making it the first house in the world that have electricity by used wind power source. The purpose of this innovation is to produce a suitable solution (pollution-free) energy generation that can replaceexisting source by using fossil fuels to generate electricity. This source from fossil fuels can causes many types of pollutions that can affects that sustainability of the environment. Wind energy is a non-conventional type of energy that is claimed to be pollution-free. Clean energy, low consumption costs, predictable construction cost reductions, a broad distribution of worldwide wind energy resources, and a significant potential for market expansion, particularly in the replacement of renewable energy, are all advantages of wind energy in terms of the environment (Liew et al., 2020).

Wind energy is the world's strongest clean energy source. One big concern is that the source of wind is always fluctuating as technology progresses. There is an almost constant source of wind generated by high-speed vehicles on the highway. Motivation for thisproject will contribute to the global clean energy trend in a feasible way. Power generation involves two processes. The first process is to use wind turbines to convert the kinetic energy of the wind into mechanical energy. Next, the second process is to pass the mechanical energyin the first process to generator. The basis for converting wind energy

into mechanical energy is conservation of mass, energy and power. Small wind turbines can be mounted along the highway to produce electricity by trapping induction wind turbines triggered by moving vehicles. This wind blowing through the wind turbines generate electricity. Electricity will beused as free power to turn on street lights or for other purposes services near the highway.

Wind turbines are divided into two groups based on the relative alignment of their rotation axes with the wind direction which is horizontal axis wind turbines (HAWT) and vertical axis wind turbines (VAWT). The main advantage VAWTs on top of HAWTs is the ability to generate electricity under any circumstances wind direction. This advantage makes VAWTs more suitable for Expressway wind power generation taking into account the wind due to the opposite direction of the vehicle and the opposite aerodynamics power can be used to drive VAWTs. VAWTs can be divided into two types, namely drag type and lifting type based on the generation mechanism of blade driving force. The Savonius Turbine and Darrieus Turbine are drag type and lift type of Vertical Axis Wind Turbine (Tian et al., 2020).

Figure 1.1: Example of Vertical Axis Wind Turbine that Installed in highway

1.1 Problem Statement

Most of the energy sources used today caused various pollutants in the air, water or soil. Therefore, new renewable energy needs to be proposed or used by each country in order to keep the sustainability of the environment for future life. The main sources that used in Malaysia to gain the electric energy is from hydropower station, thermal station, gas power station and also from burning of fossil fuels. Most of the existing source that we gain will causepollutant to the environment which affect living things. Wind energy is one of new energy thathave been discovered to be new future renewable energy that are safe to be used. Other than that, wind energy is very suitable to be used on the road to supply electricity for the use of street lights because on the road there is a high speed of wind generated from the movement ofvehicles between the two sides of the road that produces strong disturbance to the air. Therefore, the ideas are to analyses the feasibility of using wind turbine in Malaysia highway for powering the street lightings and at the same time if the power generated have excess energy, it can also use for powering traffic light, road signals and emergency road signage.

Figure 1.2: Example of Wind Turbine that used for Powering Street lighting

1.2 Objectives

The objectives of this project are as follows:

1) To study the existing research that have been done about feasibility of using wind turbine in highway.

2) To design a suitable Vertical Axis Wind Turbine (VAWT) to be placed on highway.

3) To produce small model of Vertical Axis Wind Turbine (VAWT) from its actual replica of prototype.

4) To see differences between two consecutive types of wind turbine blade model to extract as much as wind energy.

5) To conduct a testing for wind turbine model by using two approaches which is by moving three types of modified size of vehicles model and portable table fan.

1.3 Scope of Project

The scopes of this project are:

1) The design of the wind turbine that is suitable to be used on Malaysia highway.

2) The design of the wind turbine is only done by using SolidWorks Software.

3) The data of power output from two types of blades from vertical axis wind turbine model will be compared.

1.4 General Methodology

The actions that need to be carried out to achieve the objectives in this project are listed below.

1) Literature Review

   The information regarding the feasibility of using wind turbine were discovered from existing research that have been done in articles or journals.

2) Selection Type of Wind Turbine

   The suitable design for wind turbine either to use vertical type or horizontal type windturbine were chose due to its functionality and suitability at certain condition.

3) Proposing New Design Concept

   New design for Vertical Axis Wind Turbine (VAWT) were proposed to the supervisorand sketched in SolidWorks Software. Consideration must be taken to the new design such as number of blades for the wind turbine, the height of the wind turbine and lengthof the blade.

4) Produce Model from Actual Prototype

   The sketched design must be fabricated to produce small model wind turbine. The objective of producing small model is to see the movement mechanism of the wind turbine when we applied a certain amount of force to the blade (wind speed).

5) Analysis or proposed suggestion

   The produced model will be tested its suitability based on certain condition such asamount of wind applied and placement of the wind turbine. Also, we will analyze the power generated from the moving wind turbine.

6) Report Writing

   A report on this study will be written at the end of the project.

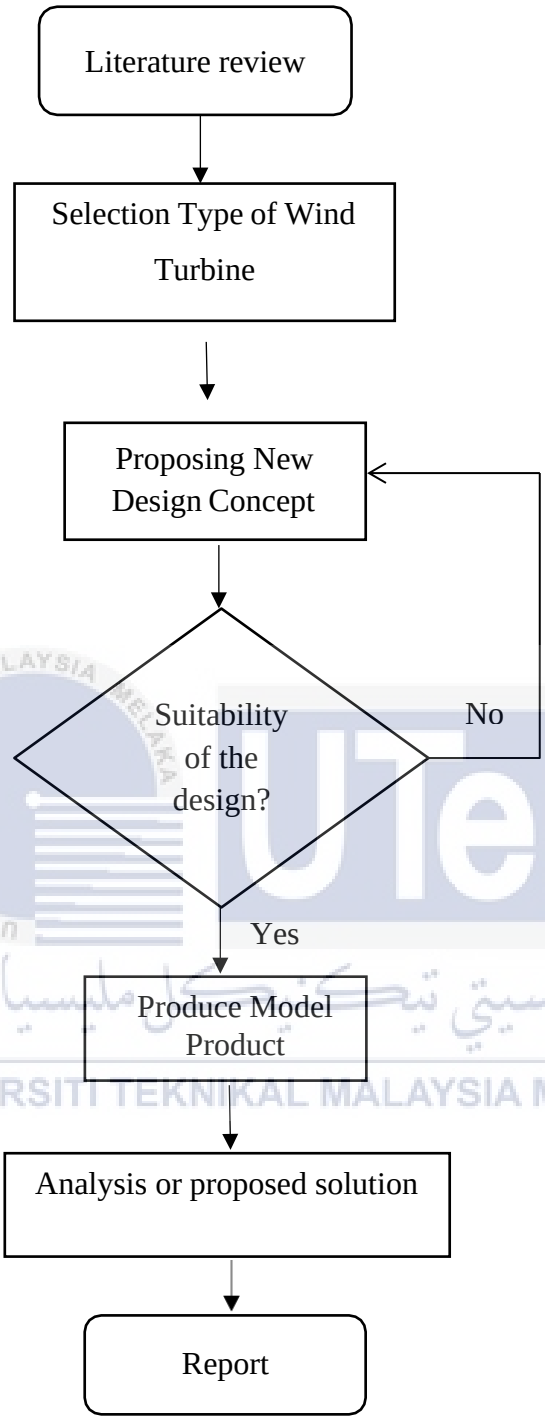

Figure 1.3: Flow Chart of Methodology