



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEVELOPMENT OF WATER FLOATING NANO TURBINE

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Mechanical Engineering Technology (Automotive Technology) with Honours

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfillment of the requirements for the degree of Bachelor of Mechanical Engineering Technology (Automotive Technology) with Honors. The member of the supervisory is as follow:



ABSTRAK

Turbin adalah satu alat untuk menghasilkan sumber tenaga baharu. Jika tenaga konvensional tidak dapat menghasilkan bekalan kepada yang memerlukan, turbin akan membantu kepada mereka yang memerlukan untuk menghasilkan sumber elektrik untuk kegunaan harian. Penukaran tenaga dari sumber semula jadi melibatkan beberapa proses, mengeluarkan tenaga kinetik dari air dan penukaran tenaga kepada tenaga mekanikal.



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ABSTRACT

Turbine is a device to produces a renewable source. If the conventional energy is unable to supply the needs, then a turbine assists to generate an electrical source for daily routine. The conversion of energy from the natural sources involves several processes, extracting kinetic energy from the water and convert it into mechanical energy.



DEDICATION

To my beloved parents

Mr. Abd Rahman Bin A Rashid and Mdm. Nor Rashidah Binti Moain

Who raised me to become a useful person, helping person and a successful person in a world and here after.



ACKNOWLEDGEMENT

I would like to express my deepest appreciation to those who provided me the possibility to complete this report. A special gratitude I give to my supervisor of Bachelor's Degree Project, Mr. Ir. Mohamad Hafiz Harun, whose contribution in stimulating suggestions and encouragement, helped me to coordinate my Bachelor's Degree Project especially in writing a report and conducting an experiment. My appreciation to my families and friends for their supports and blessing.

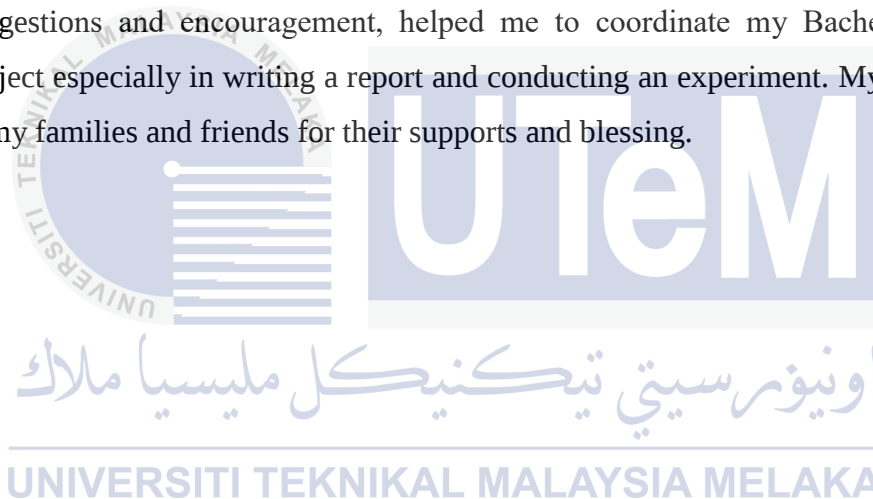


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LIST OF ABBREVIATIONS, SYMBOLS, AND NOMENCLATURE

UTeM	-	Universiti Teknikal Malaysia Melaka
CATIA	-	Computer Aided Three-Dimensional Interactive Application
CAD	-	Computer Aided Design
CAE	-	Computer Aided Engineering
PVC	-	Polyvinyl Chloride
VOM	-	Volt-Ohm Meter
V	-	Unit of Voltage (Volt)
s	-	speed / velocity of the water (m/s)
R	-	radius of turbine wheel (m)
N	-	Number of Revolution per Minute (RPM)
P	-	Pressure (Pa)
ρ	-	Water Density (kg/m^3)
g	-	Gravitational Force (m/s^2)
h	-	Height of water level (m)

CHAPTER 1

INTRODUCTION

1.1 Introduction

Electricity is one of the most important for living things to do their daily routine. From the electricity, all the private companies in the world can provide their products to the people who are needed to fulfill their daily routine. All the electrical appliances are required to operate its machine using electricity. Without any electricity, all the electrical appliances could not be operated.

Residential current usage increased every year causing by the summer season occurred in certain country affected by El-Nino. Even worse, certain residential and industries areas are always facing electricity blacked out while doing their daily routine. Another point is the people who are using smart phone are unable to charging their device as well as no electricity in their residential area or during camping.

From the natural sources, such as river, stream and ocean can generate the electricity without any problems and harmful to the people and it can reduce the usage of electric tariff of certain residential area and industries area. The conversion of energy from the natural sources to useful energy involves several steps, draw out kinetic energy from the water and transform to a form of mechanical energy at the rotor axis and process of the changing into functional energy

To make the turbine operate in good condition, it is consisting of aerodynamic and it is related from the design that we have been choose or decide. For an example, if the stream is in closure space, the aerodynamic would be very low and if the stream doesn't have any end, the aerodynamic of stream would be high.

1.2 Problem Statement

Certain residential area will face a problem which is blacked out and electrical trip during rainy season so some resident facing a difficulty regarding charging a smart phone. It also happens for outdoor activity such as hiking, camping etc.; they are facing a problem of smart phone battery drain and do not have any sources of electricity to charge their smart phone.

Therefore, this study is to help the residents and hikers on supplying electricity when there is no electricity in residential area and during hiking activities.

1.3 Objective

The objectives of this research are stated below:

1. To identify the speed of drain water.
2. To design the hydro turbine to harvest energy from water flow sources.
3. To identify the maximum voltage that can be generated by the turbine from the stream flow.

1.4 Scopes

This project will be limited to these aspects:

1. The Dassault Systèmes CATIA and SolidWorks.
2. Potential of stream flow to spin the turbine.
3. The turbine design that highly generate voltage.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

This study will provide review from previous research in order to make a large scope of water turbine and hydroelectric, obtain any turbine problems, generates new ideas and concept.

2.1 History of Hydropower

Hydropower, the vitality created from moving water, is one of the most seasoned renewable vitality sources and the aggregate worldwide electric power capacity of hydropower, including extensive hydropower, small hydropower, and ocean power, was approximately 820 GW in 2005, which represented very nearly 20% of the renewable energies. (Ren21, Renewable global status report, 2006)

Small hydropower systems have been progressively utilized as an option vitality source so that a small system is installed in small rivers or streams with little environmental effect. In this way, such small hydropower systems do not require a dam to be built.

Water turbines can be characterized by the kind of generator used, or the water assets in the installed place. The mostly used generally is a water-heat turbine system, and this makes the turbine rotate by changing the potential energy of the water into kinetic energy. The advantage of this turbine is high efficiency, however the cost of

constructing a dam or waterway is high and causing significant environmental problems. Water stream turbines are rotated by the force of the river or the ocean current. These turbines are essentially like wind turbines underwater, except that the density of water is 800 times greater than air. There are two types of water stream turbines; horizontal axis turbines and vertical axis turbines.

2.2 History of Turbine

The idea of using naturally moving water or air to help do work is an ancient. Water wheels and windmills are the best models of ancient mankind's ability to apprehension some of nature's energy and put it to work. The water wheel, occasionally called a 'noria', used for collecting water from a flowing source to irrigation was used around the 5th century B.C.

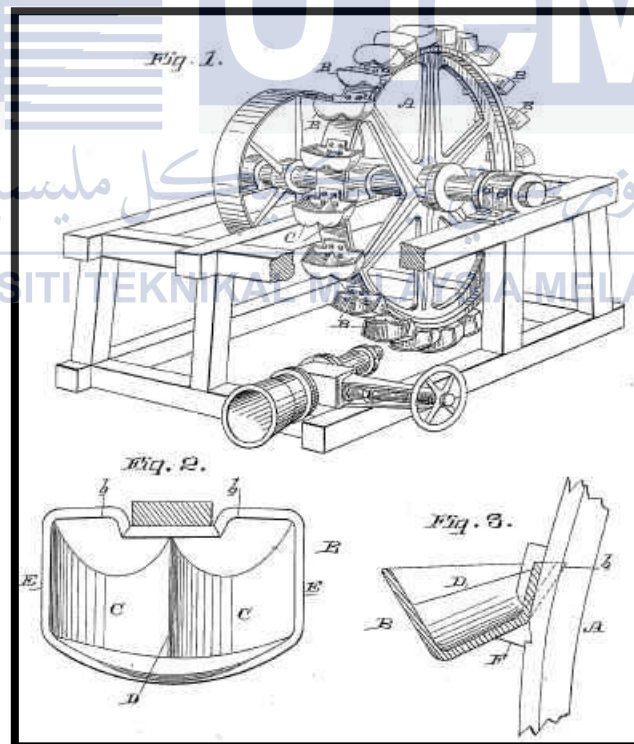


Figure 2.0: Early development of water turbine with buckets.

Around the 2nd century B.C, watermill devices were created and it originally used for grinding grains. Hydroelectric power was slow to develop and with the later steam engine designation, the growth in hydroelectric power technology was hindered.

The word turbine was presented by Claudin Burdin, a French engineer in the mid-19th century and is acquired from the Latin language, “spinning” or a “vortex”. The dominating contrast between early water turbines and water wheels is a water winding component which movements’ energy to a spinning rotor.

The most punctual known water turbines date to the Roman Empire with two helix-turbine mill locales on 3rd or early 4th century A.D. The horizontal water wheel with calculated cutting edges was installed at the base of a water-filled, circular shaft. The water from the mill-race entered the pit digressively, making a winding water segment which made the completely submerged wheel act like a genuine turbine. (Wilson, 1995). Fausto Veranzio in his book *Machinae Novae* (1595) depicted a vertical axis with a rotor is like a Francis turbine. (C Rossi; F Russo, *Ancient Engineers’ Invention*, 2009).



Figure 2.1: Roman turbine mill at Chemtou, Tunisia. The tangential water inflow of the millrace made the submerged horizontal when in the shaft turn like a true turbine. (Wilson, 1995)

Segner wheel was developed by Johann Segner, the mid-18th century reactive water turbine in Kingdom of Hungary. It had a horizontal axis and was a predecessor to modern water turbines. In the 18th century Dr. Barker developed a similar reaction hydraulic turbine that became popular as a lecture-hall demonstration.

2.3 Types of water turbine

There are two types of water turbines which are Reaction turbines and Impulse turbines. The type of hydropower turbine selected project is based on the height of standing water – referred to as “head” – and the flow, or volume of water, at the site.

2.3.1 Impulse turbine

The impulse turbine or a drive turbine generally uses the water speed to move the runner and releases to atmospheric pressure. The water stream hits every basin on the runner and no suction on the drawback of the turbine, and the water streams out the base of the turbine lodging after hitting the runner.

—An impulse turbine mostly suitable for high head, low flow applications.

2.3.1.1 Pelton Wheel

This turbine invented by Lester Allan Pelton in the 1870s. This wheel produces energy from the moving water impulse, as opposed to water's dead weight like the traditional overshot water wheel. It is so many dissimilarities of impulse turbines existed prior to Pelton's design but less efficient than Pelton's design.

The uses of Pelton wheels are the favored turbine for hydropower, when accessible water source moderately high hydraulic head at low stream rates, where the Pelton wheel geometry is most appropriate and it different on sizes.

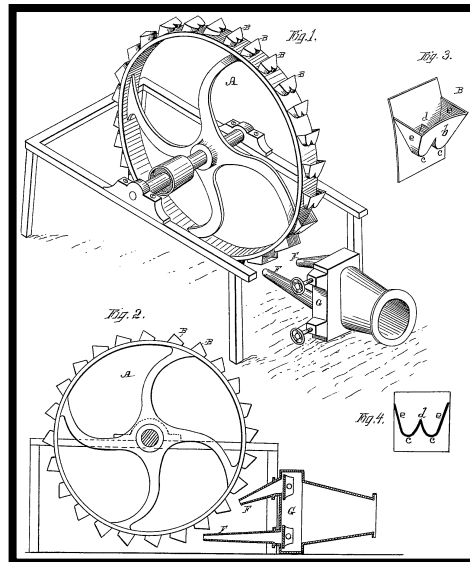


Figure 2.2: The original Pelton wheel turbine on October 1880

The functions of Pelton wheels are direct forceful nozzles, high-speed flow of water to a series of rotating spoon-shaped buckets, also known as impulse blades, which are mounted around the circumference of the rim of the rim wheel drive called runner. As the water jet influences contoured bucket-blades, the direction of water velocity changed to follow the bucket contours. Water impulse energy applies torque on the bucket-and-wheel system, spinning the wheel; the water stream itself does a “U-turn” and exits at the outer sides of the bucket, decelerated to a low velocity.

2.3.1.2 Cross-flow turbine

A cross-flow turbine is drum-shaped and utilizes an extended, rectangular-section spout coordinated against curved vanes on a cylindrically shaped runner. Different names were known as Bánki Michell turbine or Ossberger turbine (E. F. Lindsley, Water power for your home, 1977), is a water turbine imagined by the Australian Anthony Mitchell, the Hungarian Donát Bánki and the German Fritz Ossberger. Michell got licenses for his turbine design in 1903, and the manufacturing company Weymouth made it for many years.

Ossberger's first patent was conceded in 1933 ("Free Jet Turbine" 1922, Imperial Patent No. 361593 and the "Cross Flow Turbine" 1933, Imperial Patent No. 615445), and he fabricated this turbine as a standard product.

Crossflow turbines are normally worked as two turbines with various capacity and sharing the same shaft. The turbine wheels are the same diameter, but different lengths to haft different volumes at the same pressure. The wheels divided are often built with volumes in ratios of 1:2. The subdivided managing unit, the guide vane system in the turbine's upstream section, prepares flexible operation, with 33, 66 or 100% output, contingent on the flow. Low working expenses are acquired with the turbine's relatively simple construction.

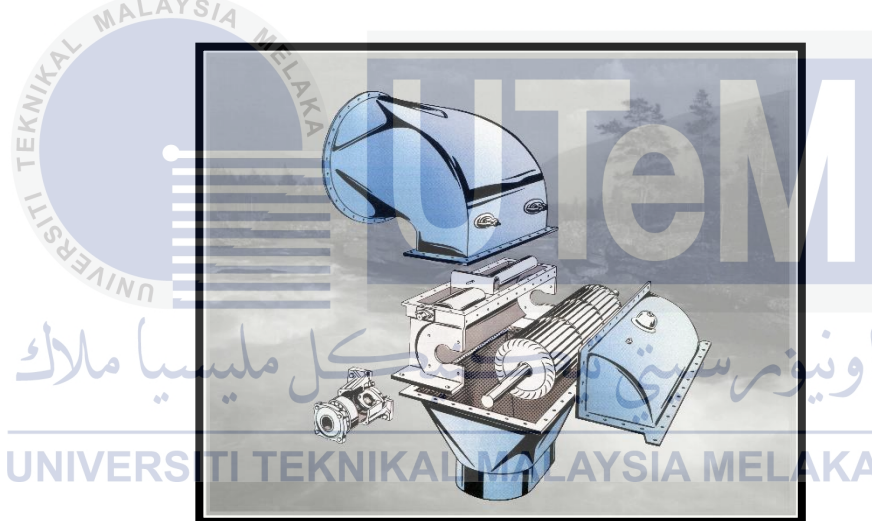


Figure 2.3: Ossberger turbine section

The turbine comprises of a barrel shaped water wheel or runner with a horizontal shaft, made of various blades, arranged radially and tangentially. The blade's edges are sharpened to decrease resistance to the stream of water. A blade is made in a cross-section (pipe cut over its whole length). The blades ends are welded to disks to form a cage like a hamster cage and are sometimes called "squirrel cage turbines"; Instead of the bars, the turbine has the trough shaped steel blades.

2.3.2 Reaction turbine

A reaction turbine develops power from the combined action of pressure and moving water. The runner is placed directly in the water stream flowing over the blades rather than striking each individually. Reaction turbines are generally used for sites with lower head and higher flows than compared with the impulse turbines.

2.3.2.1 Francis Turbine

The Francis turbine is a water turbine type that was invented by James B. Francis in Lowell, Massachusetts (Lowell Massachusetts). It is a turbine of an inward-flow reaction that combines radial and axial flow concepts.

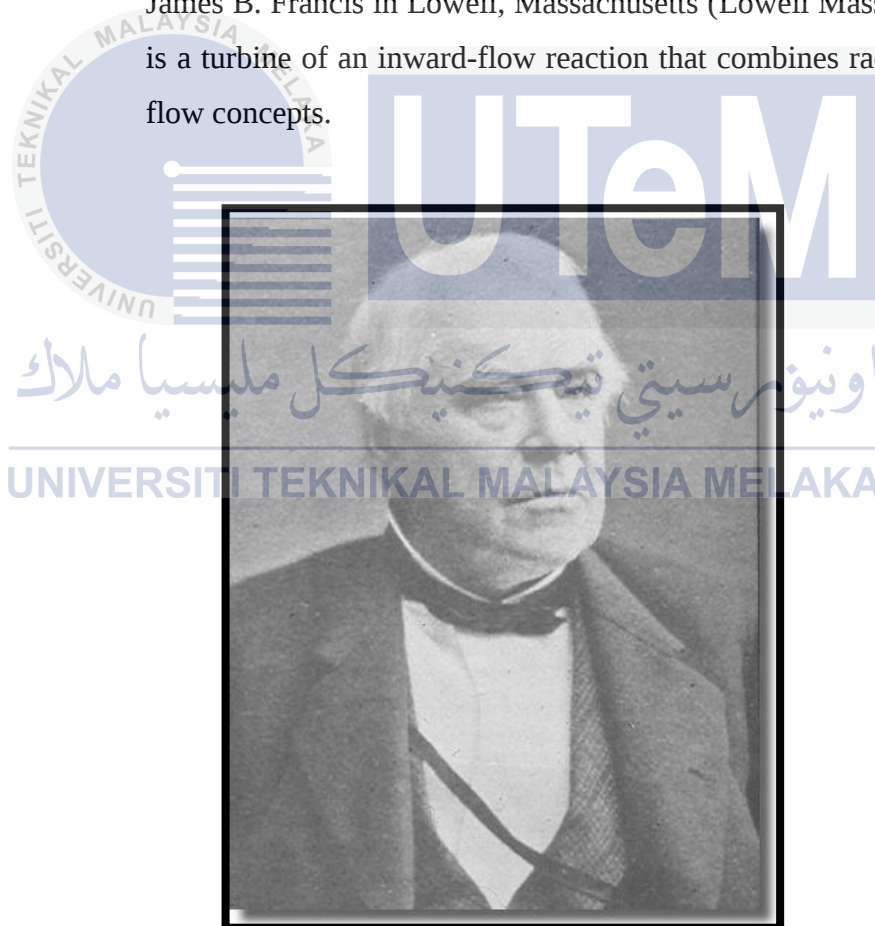


Figure 2.4: A developer of Francis Turbine, James B. Francis. (Lowell Massachusetts)

Before develop a turbine, Francis had developed a power canal to supply water power to the mills in 1845 and after eighteen months, in year of 1848 Francis completed the 5.6 miles of canals in his hometown, Lowell. With the completed of canal system, Francis turned his attention to turbines.

Originally the mills had used waterwheels or breast-wheels that rotated when filled with water. These types of wheels could achieve a 65 percent efficiency rate. One such problem with these wheels was backwater which prevented the wheel from turning. Studying the Boyden turbine Francis could redesign it to increase efficiency. Francis could achieve approximately 88 percent efficiency rate by constructing turbines as “sideways water wheels”.

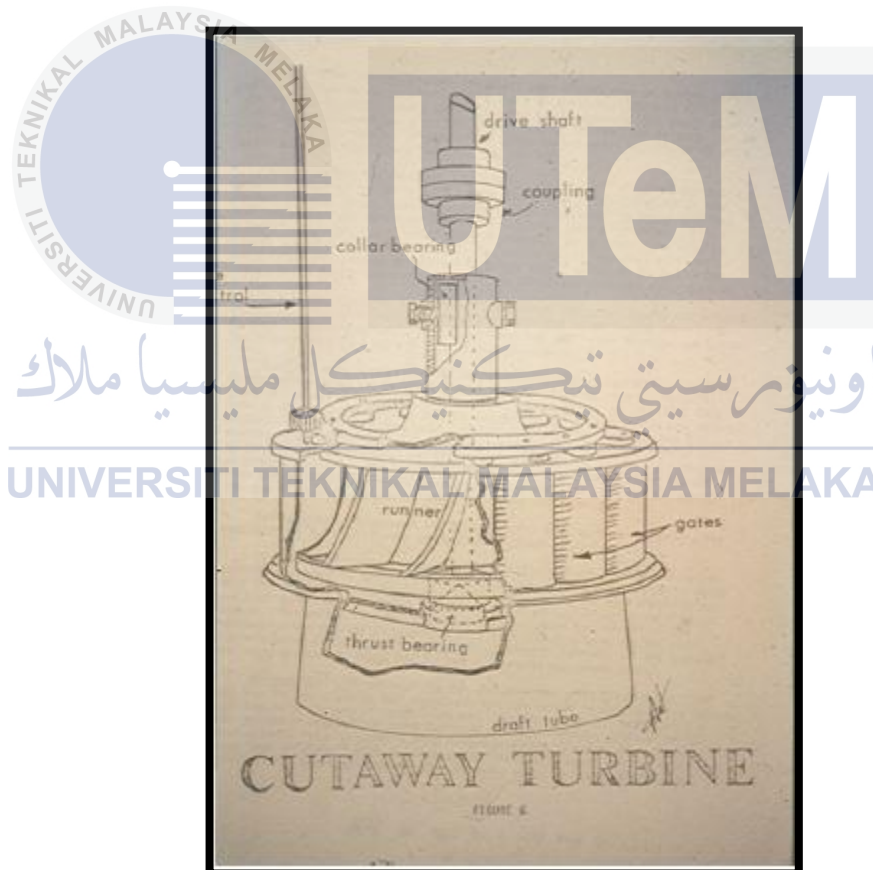


Figure 2.5: Francis Turbine development also known as “sideways water wheels”

After further experimenting, Francis developed the mixed flow reaction turbine which later became an American standard. Twenty-two of the “Francis turbines” reside in Hoover Dam. Everything works of these turbines then published as *The Lowell Hydraulic Experiment* in 1855.

2.4 Axis of Turbine

There is various type of turbine axis but mainly used are horizontal axis turbine and vertical turbine. Most of horizontal axis turbine using propeller type of turbine. It consists of two or three blades and a single or twin rotor system. The rotor rotated by the lift force generated by the fluid flow. The turbine can generate in one way flow or two-way flow, according to the geometric shape of the rotor blade and pitch control mechanism.

A vertical axis water turbine, also known as a cross-flow turbine and it is based on the Darrieus wind turbine which is rotated by the lift and drag forces (Paraschivoiu I, Wind turbine design with emphasis on Darrieus concept, Polytechnic International Press, 2002). The vertical axis type has the advantage that the rotor can be rotated regardless of the flow direction.

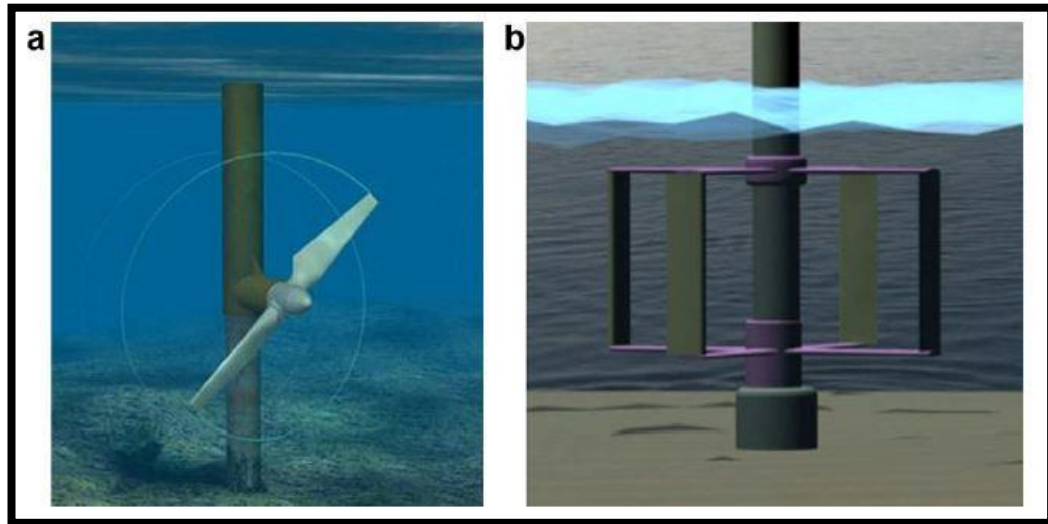


Figure 2.6: Water stream turbines (a) Horizontal axis water turbine, (b) Vertical axis water turbine. (S. Hwang, Y. H Lee, S. J Kim, et al, 2008)

The water stream turbine has not been commercialized now; however, this turbine is increasingly being recognized as a tidal power generation system in many countries, including UK, USA, Canada, and Norway. The MCT Technology, in UK, developed a marine current turbine of 300 kW in 2003, which was installed in Lynmouth, Devon for experimental purposes. They also installed a twin rotor system rated at 1 MW in 2007 for the prototype and test-bed for the commercial technology (Electric Power Research Institute (EPRI), Tidal in stream energy conversion stream energy conversion feasibility demonstration project, 2005).

2.5 Floating Water Turbine Concepts

2.5.1 Floating axis tidal turbine

The inclined axis concept is only applicable to small hydro power because the design of pivot mechanism is difficult in heavy turbine load. The wind turbine is on a rotating spar buoy which does not have any internal rotary machinery. The torque of wind turbine is derived by contacting rollers installed off-turbine-axis on the secondary float. The secondary float position is kept by catenary cables connected to on-deck mooring points. The same torque

converting unit for offshore wind application can be used in the water stream turbine.

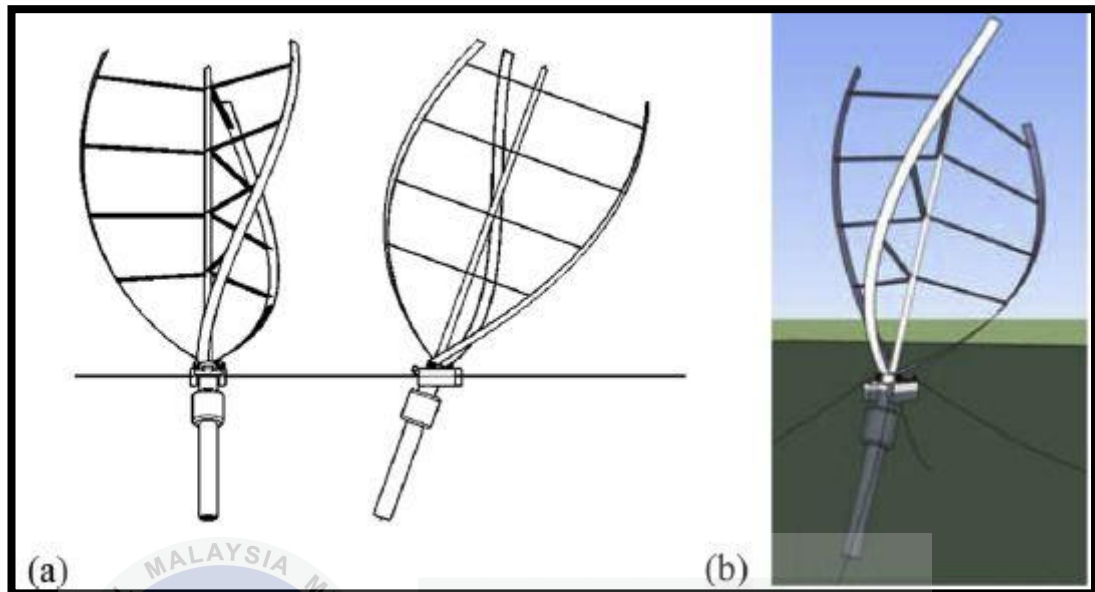


Figure 2.7: Images of floating axis wind turbine (H. Akimoto, et al, renewable energy); (a) front and side view; (b) perspective view.

2.5.2 Inclined axis stream turbine

Fig. 2.10 shows major configurations of stream turbine. Turbines are placed on the sea bottom as shown in Fig. 2.10 (a) or supported by a float in Fig. 2.10 (b). There are both horizontal and vertical axis layouts. Their turbine units need to be raised above the water surface for regular maintenance and cleaning. It requires a specially designed service vessel or an elevation mechanism.

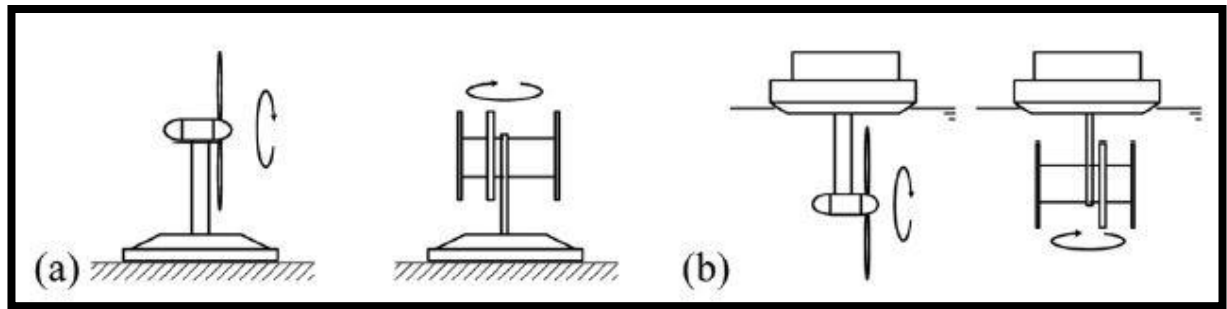


Figure 2.8: Water stream turbine configurations; (a) horizontal axis and vertical axis turbines placed on a sea bed; (b) horizontal axis and vertical axis turbines placed on a sea bed supported by a float.

The sweep area of turbine tends to be relatively small in the total dimensions of device. Although it can use buoyancy for partially supporting submerged structures, utilized range in depth direction has a significant limitation because of high hydrodynamic load on the turbine. If the size of the turbine is expanded, it leads to considerable increase of the supporting structures and the structural strength at the root of the vertical axis turbine to keep the upright position of the turbine system.

To solve these problems, the authors abandon the concept of keeping upright position of the turbine as shown in Fig. 2.9. It is like a vertical axis turbine. However, the turbine axis swings around the pivot on a supporting structure or on a float. The inclination angle is passively adjustable to stream speed and is determined in the balance of hydrodynamic force, buoyancy and weight of the turbine. The torque converting unit that contains a generator and gearbox swings with the turbine axis so that the unit does not experience high bending moment.

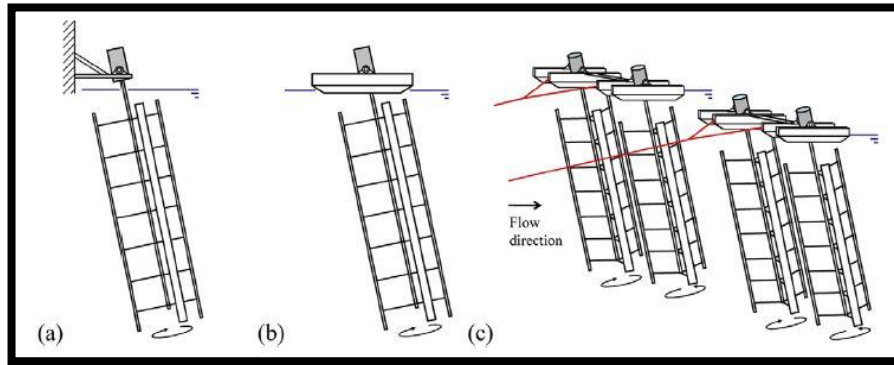


Figure 2.9: Inclined axis water turbine on a supporting structure (a) and on a float (b); small farm of moored inclined axis turbines (c).

For maintenance access, the turbine axis swings to near the water surface by being pulled up at the lower end of the turbine using a cable outside of the system. Since bending moment on the root of turbine axis is no longer a significant problem, we can employ long blades and obtain larger swept area with high aspect ratio. It utilizes wider depth range of water stream without scaling up the support structure. The device can be installed on onshore structure or on a float as shown in Fig. 2.11 (a) and (b). The array of moored turbines captures water stream energy efficiently as shown in Fig. 2.11 (c).

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2.6 Generators

Generator is a device that converts mechanical energy to electrical energy for use in an external circuit. The generator can be used to produce electric power, and as an electromotor to produce mechanical rotational energy. The generator can draw out electric power by utilizing any source of energy, especially suitable being driven by wind and water currents, low-speed water currents. An energy reverse conversion from electrical energy into mechanical energy was done by electric motor. Many motors can be mechanically driven to generate electricity and frequently make acceptable generators.

Electromagnetic generators fall into one of two broad categories, dynamos, and alternators. Dynamos generate direct current, usually with voltage or current fluctuations, usually using commutator. Alternators generate alternating current, which may be rectified by another system.

2.7 Drainage

During rain or irrigation, the fields, soils, and streets get to be distinctively wet. The water invades into the soil and stored in its pores. When all the pores are loaded with water, the soil is said to be immersed and no more water can be assimilated; when rain or irrigation continues, pools may form on the soil surface.

2.7.1 Types of drainage

Drainage can be either natural or simulated. Numerous zones have some natural drainage; abundance water flows from the agriculturists' fields to swamps or to lakes and ways. Natural drainage, however, is often inadequate and artificial or man-made drainage is required. There are two types of artificial drainage or man-made drainage: surface drainage and subsurface drainage.

Surface drainage is the removal of excess water from the surface of the land. This is shallow trench achieved called open drains. The shallow trench release into larger and deeper collector drains. To encourage the flow of abundance water towards the drains, the field is given an artificial slope by method of land grading.

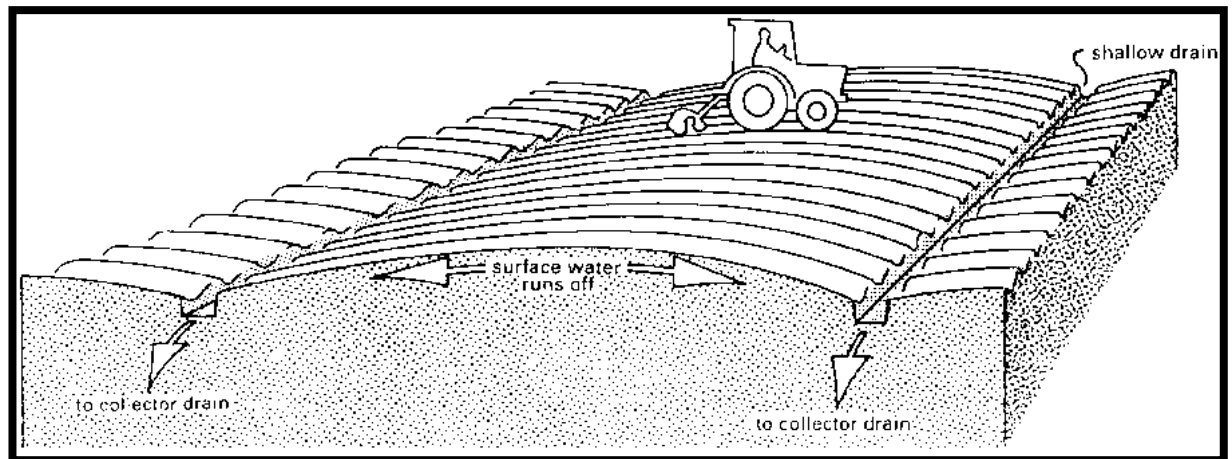


Figure 2.10: The artificial slope field to facilitate drainage

Subsurface drainage is the way of removing water from the root zone. Deep open drains or buried pipe drains accomplish it. Deep open drain is the excess water from the root zone flows into the open drains.

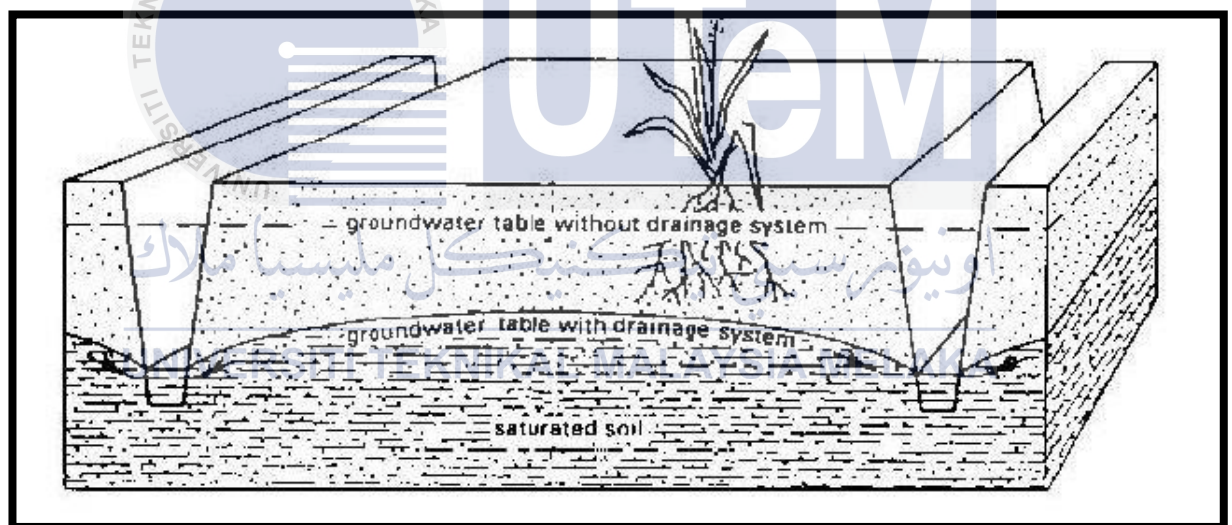


Figure 2.11: Deep open drains type

Pipe drains type is the pipes that buried in a soil with openings through which soil water can enter. The pipes convey the water to a collect drain.

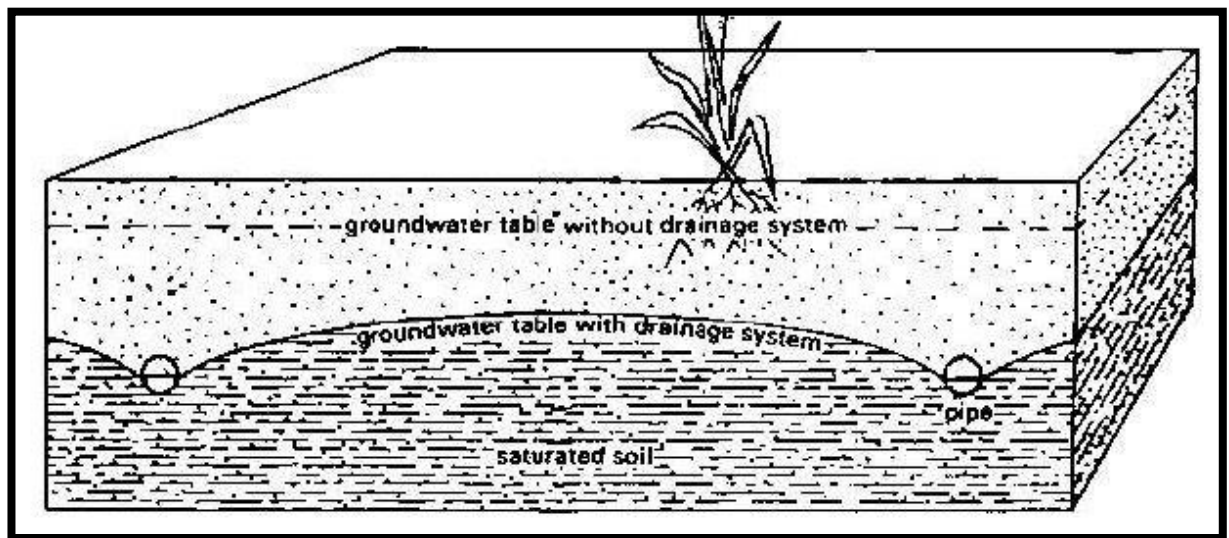


Figure 2.12: Pipe drains type

2.8 Water Flow

There are several types of water flow which are characterized by their size, frequency, timing, and duration.

Cease to flow is a type in which may lead to either total or partial drying of the river channel, depending on system specifics. With this type of flows comes with the period of no discernible in flow in a river. It also reducing numbers of exotic pest species benefits.

Low flows type generally provide a continuous flow through channel. This may either maintain the flow above a 'cease to flow', or provide habitat as a change from 'high flows'.

Type of high flows tenacious increments in the seasonal base flows that remain within the channel. High flows do not fill the channel to ‘bankfull’. It allows for fish migration and enhances recreational fishing opportunities.

Bankfull flows type is a flow of adequate size to reach the top of the river bank with minimal low spilling onto the surge torment. It advantages is an important trigger for fishing breeding and helps with sediment movement bank maintenance. It also improves recreational opportunities.

For Overbank Flows, it is prominent than ‘bankfull’, bringing about immersion of the neighboring natural surroundings. Overbank flows are critical for a range of ecological factors, including flood pain productivity. To avert harm to individuals and property, ecological water is not discharge to provide overbank flows on private land.



2.9 Design Model

2.9.1 Dassault Systèmes SolidWorks

SolidWorks is a solid modelling computer-aided design (CAD) and computer-aided engineering (CAE) computer program that runs on Microsoft Windows operating systems and it is published by Dassault Systèmes.

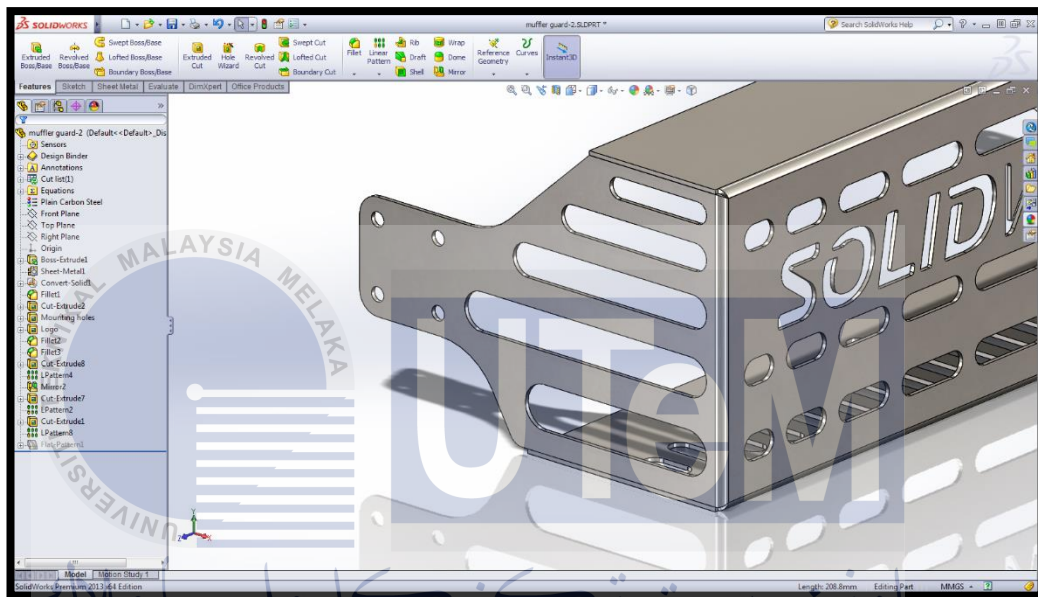


Figure 2.13: The interface of Dassault Systèmes SolidWorks

SolidWorks Corporation was established in December 1993 by Massachusetts Institute of Technology graduate Jon Hirschtick. At first situated in Waltham, Massachusetts, Hirschtick enlisted a group of engineers with the objective of building 3D CAD software that simple-to-utilize, affordable, and accessible on the Windows desktop. SolidWorks released its first product *SolidWorks 95*, in November 1995 (SolidWorks Company History, SolidWorks Company Information).

The advantages of using Dassault Systèmes SolidWorks software are:

- i. Middle-range software : User that uses AutoCAD can go through with this SolidWorks without any problems.
- ii. User friendly : SolidWorks is user friendly to the user to form a drawing with all shortcut icons are ready to click by the user without entering commands.
- iii. Paperless Environment : This software just no need papers to draw. It can be saved in various type of format and can be opened in other computers.
- iv. Easily edit : User can do minor or major changes of drawing with just edit on the drawing in this software.
- v. Unlimited drawing size: User can draw for unlimited size of drawing. It can change the drawing scale in properties in this software.

The disadvantages of using Dassault Systèmes SolidWorks software are:

- i. Requires high-spec of computer : A low-spec of computer is not supported to run SolidWorks
- ii. Costing of SolidWorks installation: A software costs of thousand dollars for higher version for experts.
- iii. Continuous updating equipment : Certain equipment and component needs an update in order to use the equipment.
- iv. Requires special skill : It requires skill to draw using SolidWorks.
- v. Data storage fragile : High probability of data corruption if it saved in storage for an example in a computer hard disk.

2.9.2 Dassault Systèmes CATIA

CATIA is an acronym of Computer Aided Three-Dimensional Interactive Application, a multi-stage computer-aided design (CAD)/ computer-aided manufacturing (CAM)/ computer-aided engineering (CAE).

It was begun as an in-house development in 1977 by French aircraft manufacturer Avions Marcel Dassault, around then client of the CAD/CAM software to build up Dassault's Mirage fighter jet.

In November 2010, Dassault Systèmes launched CATIA V6R2011x, the most recent arrival of its PLM2.0 platform, while keeping on supporting and enhance its CATIA V5 software. In June 2011 and above, Dassault Systèmes launched V6 R2012 and upgraded every year to the most up to date software. In the latest version of Dassault Systèmes were 3DEXPERIENCE Platform R2014x and CATIA on the Cloud, a cloud version of its software.

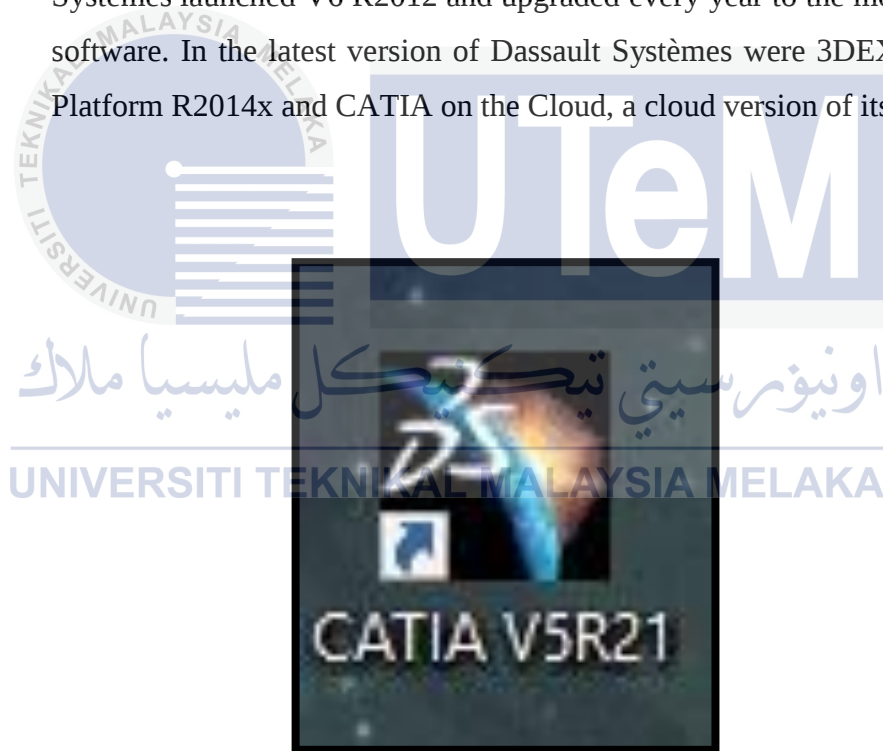


Figure 2.14: Dassault Systèmes CATIA V5R21

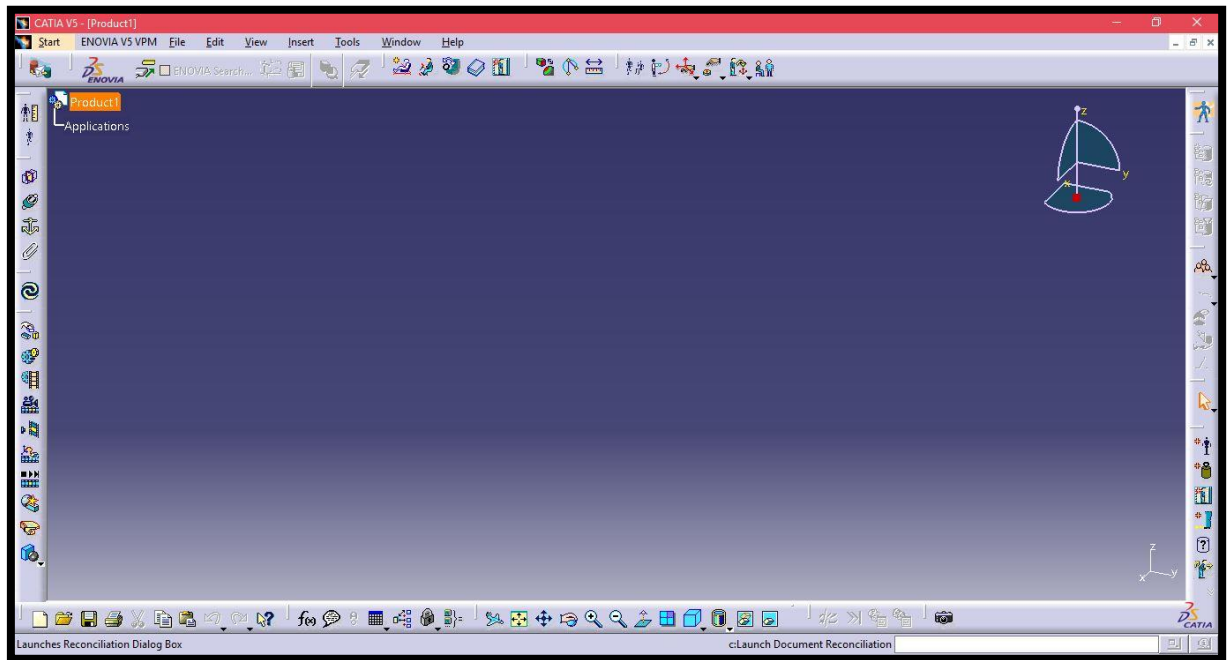


Figure 2.15: Interface of Dassault Systèmes CATIA V5R21

The advantages of using Dassault Systèmes CATIA software are:

- i. Top-range software : can produce CAD, CAE and CAM in CATIA software
- ii. User friendly : CATIA is user friendly to the user to form a drawing with all shortcut icons are ready to click by the user without entering commands.
- iii. Paperless Environment : This software just no need papers to draw. It can be saved in various type of format and can be opened in other computers.
- iv. Easily edit : User can do minor or major changes of drawing with just edit on the drawing in this software.
- v. Unlimited drawing size : User can draw for unlimited size of drawing. It can change the drawing scale in properties in this software.
- vi. Easily do analysis : All 3D drawing can do analysis either in parts drawing or in assembly drawing easily.

2.10 Current Measurement Device

2.10.1 Multimeter

A multimeter or a multi analyzer, known as a VOM (volt-ohm meter or volt-ohm milliammeter), is an electronic measuring instrument joining a few estimations works in one unit. A common multimeter can quantify voltage, current and resistance. Two types of multimeter are essentially used to quantify electric esteem which is analog multimeter and digital multimeter.

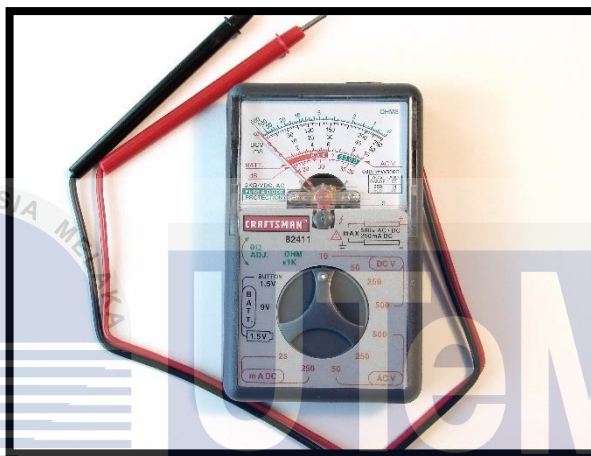


Figure 2.16: An analog multimeter

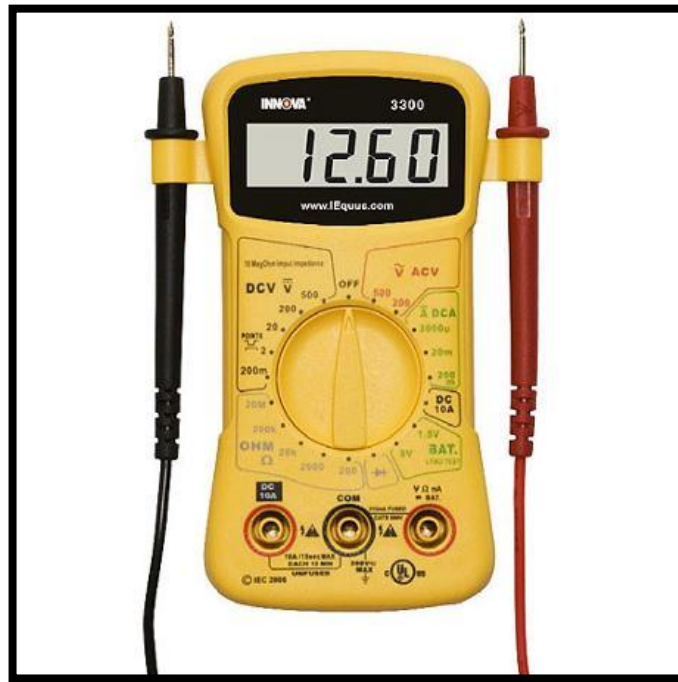


Figure 2.17: A digital multimeter

Analog multimeters use a micro ammeter with a moving pointer to display readings. Meanwhile for digital multimeters have a numeric display, and may also show a graphical bar representing the measured value.

A multimeter can be a hand-held device useful for basic fault finding and field service work, or a bench instrument which can measure to a very high degree of accuracy. It can be used to troubleshoot electrical problems in a wide array of industrial and household devices such as electronic equipment, motor controls, domestic appliances, power supplies and wiring systems.

With all review of literature from the past and decided to choose an Impulse Turbine type because in this project, water velocity is the main sources to operates the turbine. With using an impulse turbine, the axis of turbine also has been decided by choosing a horizontal axis to mount the turbine. To develop this project, design model has been chosen and will use Dassault Systèmes CATIA and SolidWorks to build a project because easily to do analysis in each part that will used in this project. After the turbine is mounted to the project, the measurement current will be taken using digital multimeter to take the measurement current value.

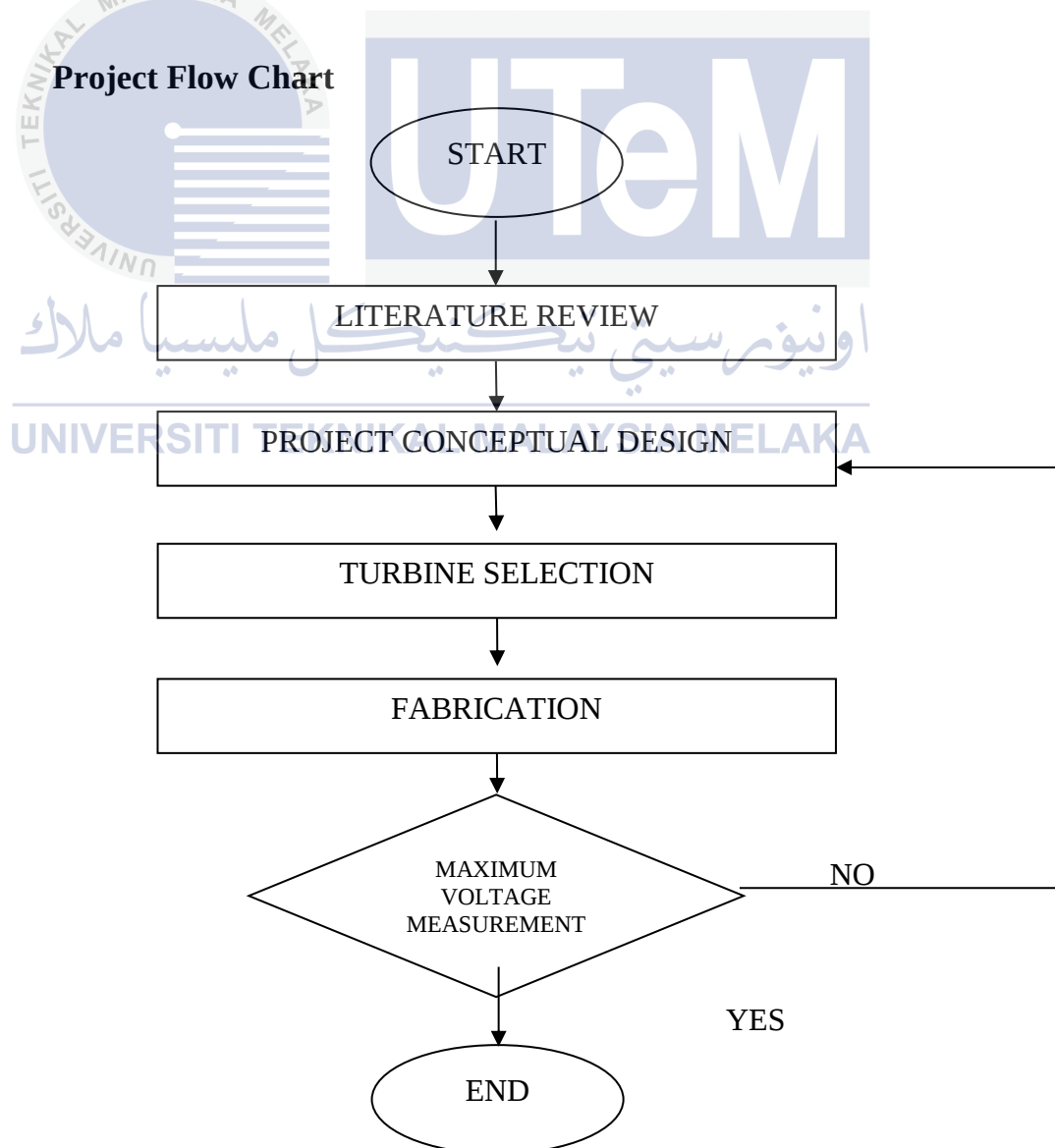
CHAPTER 3

METHODOLOGY

3.0 Introduction

This study will provide a flow chart review of Bachelor's Degree Project to understand how the project is made. At this level, students need to form a flow chart and briefly explain each of the project progress.

3.1 Project Flow Chart



3.2 START

The project starts with the selection of the project title which students need to choose title that suitable for them to develop a project based on the title given and then fill the PSM registration form and submit to supervisor. Decision has been made and decides to choose a title “Development of Water Floating Nano Turbine” to fulfill the requirement of university subject.

3.3 LITERATURE REVIEW

At this stage, students need to read articles and journals of the existing products before doing the project to give the project title strong in terms of evidence for the existing products. Other words, students need to observe on the existing products about the limitation of current products, what are the advantages and disadvantages of current products, what the costs of development of current products are and what kind of data obtained while developing the current products. After that, students need to conclude all the literature review by what are the method needs to use to apply on the project.

3.4 PROJECT CONCEPTUAL DESIGN

For the project of Development of Water Floating Nano Turbine, the existing product of water floating turbine had been surveyed in a market and did some sketching for the new products. Most of current products focused only for the stream during hiking or camping.

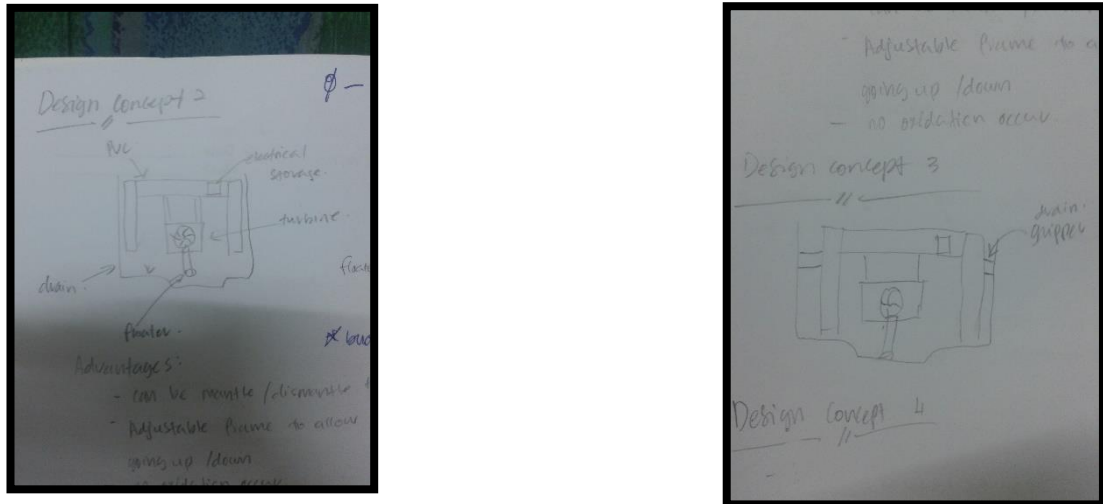


Figure 3.0: Sketching of design concept without drain gripper (left) and sketching with drain gripper (right).

When supervisor approves project sketching, then it will design using computer software which is Dassault Systèmes CATIA to get the real image of the project.

3.5 TURBINE SELECTION

To fulfill the project of Development of water floating Nano Turbine, turbine selection has been made and decided to choose Impulse Turbine type to apply on the project. This project will use the water velocity of drainage to operate the turbine and then measure the maximum value of current produced.

3.6 FABRICATION

In this method, the development of project will use a PVC pipe to fabricate the design and mount turbine on the project. The fabrication of the project includes of using glue, the L-joint shape PVC pipe and drainage gripper to hold the project in drainage.

3.7 MAXIMUM VOLTAGE MEASUREMENT

While develop this project with turbine attached on the project, measurement of electric current will be taken based on the position of the turbine. If the data of electric current measurement is small and inaccurate, then the design of the project needs to do minor change to get the highest value of current measurement. To get the current measurement value will using a multimeter as the main device to capture values while turbine is rotating.



CHAPTER 4

RESULT & DISCUSSION

This chapter discuss the Development of Water Floating Nano Turbine. The capacity of total voltage can be generated, what types of rotating turbine and drawing analysis of the turbine.

To obtain the reading of voltage, four checkpoints on the drainage had been observed. This observation was to compare the voltage obtained with different checkpoints in terms of water speed. This experiment was conducted at Taman Tasik Utama, Ayer Keroh Melaka. Dimensions of the drainage is 450mm in height and 720mm width.



Figure 4.0: First checkpoint of drainage.



Figure 4.1: Second checkpoint of drainage.



Figure 4.2: Third checkpoint of drainage.



Figure 4.3: Fourth checkpoint of drainage.

Then experiment has been conducted to these four checkpoints by taking data using multimeter to collect all readings of voltage.



Figure 4.4: Taking a data on each checkpoint.

All data obtained converted into table form to show the data difference on each checkpoint. Every checkpoint was given a different voltage generated as in table below and distance also was set on every checkpoint which is approximately two meters.

Table 4.0: Tabulated data of output voltage.

Checkpoint	Distance (m)	Drainage Height (mm)	Water Height (mm)	Time (s)	Water Velocity (m/s)	Output Voltage (V)	Turbine Speed (RPM)
1	2	450	430	14.73	0.14	0.03	36.95
2	2	450	430	11.16	0.18	0.04	47.502
3	2	450	430	10.33	0.194	0.11	51.197
4	2	450	430	8.91	0.224	0.19	59.114

Based on tabulated data above, when the output voltage is increase with the water velocity also increase. The starting output voltage produced 0.03 V at first checkpoint and the velocity of water giving a lowest value which is 0.14m/s. This might cause the drainage surface was flat at the first and second checkpoint so that the water velocity is moving slower. On third checkpoint, the output voltage produced 0.11 V which is increasing drastically and then the voltage keep increasing until the fourth checkpoint which produced 0.19 V. The last two checkpoints water velocity also increasing which are 0.194 m/s and 0.224 m/s respectively. In terms of time taken in seconds, from the first checkpoint until the fourth checkpoint, time become descending as the output voltage give higher reading which is from 14.73 s and the shortest time is 8.91 s.

For the turbine speed, calculation of the turbine speed at each point is required. The formula of calculation is as below:

$$s = \frac{2\pi RN}{60} \quad (4.1)$$

Where:

s: speed / velocity of the water (m/s)

R: radius of turbine wheel (m)

N: Number of Revolution per Minute (RPM)

As the velocity of water has been calculated using the formula of:

$$v = \frac{\text{distance (m)}}{\text{time (s)}} \quad (4.2)$$

The results of turbine speed can be obtained by using the formula 4.1. R is representing turbine wheel radius which is 36.185 mm and so that the values of turbine wheel rotation are presented. For the first checkpoint, a turbine speed produced a voltage of 0.03 V is 36.95 RPM and it is keep increasing until the fourth checkpoint, while the highest turbine speed is 59.114 RPM produced 0.19 V of output voltage.

Figure 4.5 shows the output voltage against water velocity graph. It shows that the lowest value of output voltage on first point then it slightly from 0.03 V to 0.04 V with the water velocity 0.14 m/s and 0.18 m/s increases water velocity respectively. Then when come to third checkpoint, the graph is drastically increases until the fourth checkpoint. This might be a drainage surface is slightly slope so that the water flow become higher and it can generate higher output voltage.

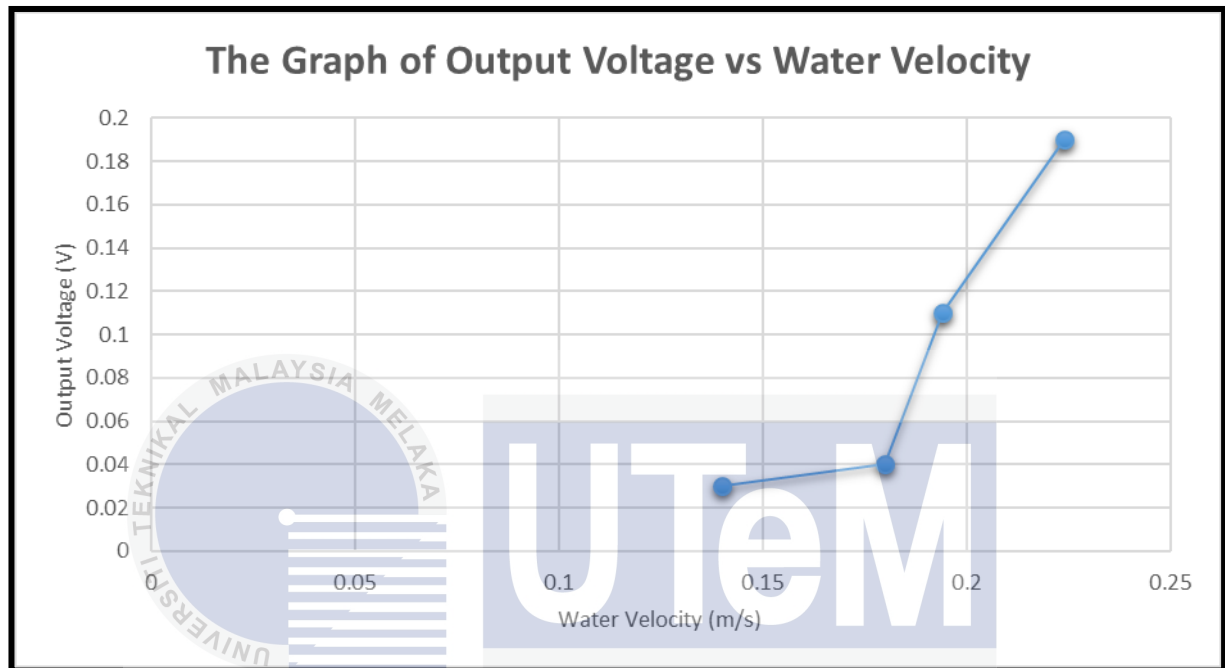


Figure 4.5: The Graph of Output Voltage vs Water Velocity

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Figure 4.6 shows the turbine speed against output voltage. As on windmill, when the speed of air increases, the voltage produced also increases. This case is applied as on windmill, where the turbine speed increases, the output voltage also increases. The water velocity influences the increases of turbine speed so that the output voltage can be obtained in highest value. There is another point that influence the turbine speed which is the level of drainage surface. When the drainage surface is slope, so the water velocity become higher and it can rotate the turbine more speed.

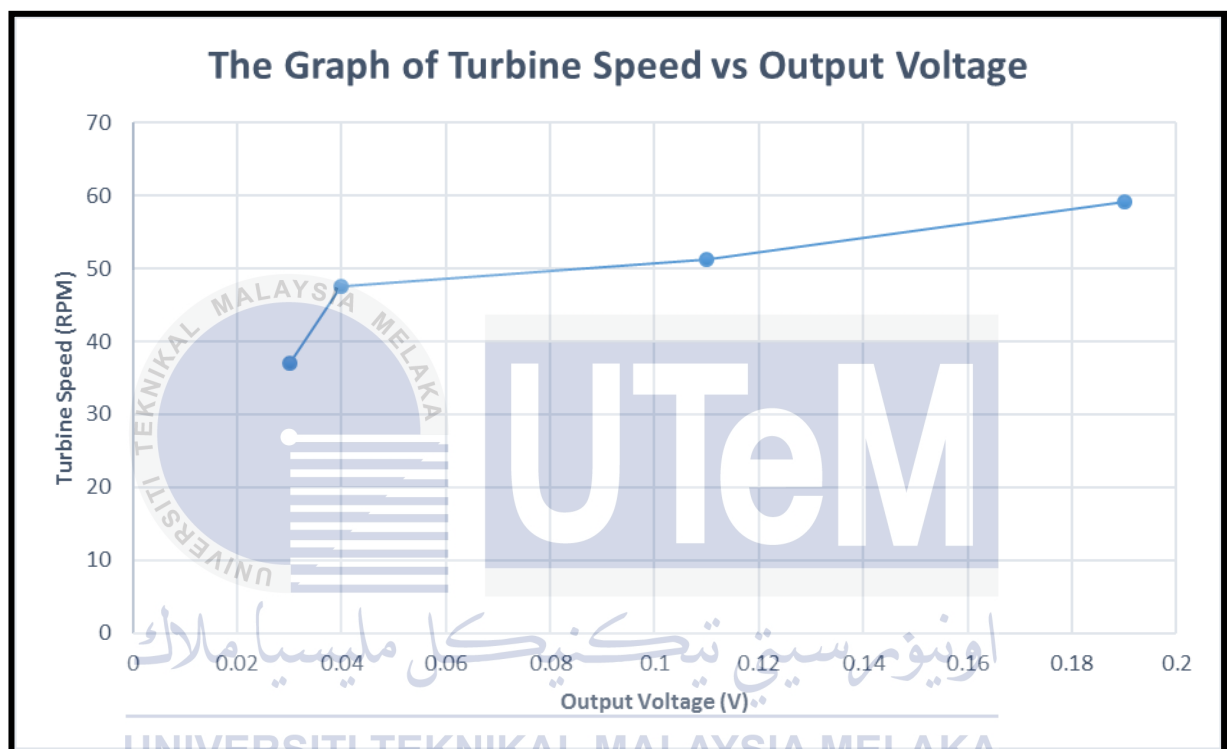


Figure 4.6: The Graph of Turbine Speed vs Output Voltage.

Figure 4.7 shows the turbine analysis using Dassault Systemes SolidWorks to analyze which part of the turbine give good reading when drainage water is reached turbine bucket. This analysis of turbine, the closed space is needed to obtain the flow trajectories so that the results are more clear for observation. In flow trajectories, it gives the highest velocity which is around 13.897 m/s to 16.213 m/s. As on experiment, the highest value of water velocity is 0.224 m/s and it slotted in the lowest flow trajectories which is from 0 m/s until 2.136 m/s.

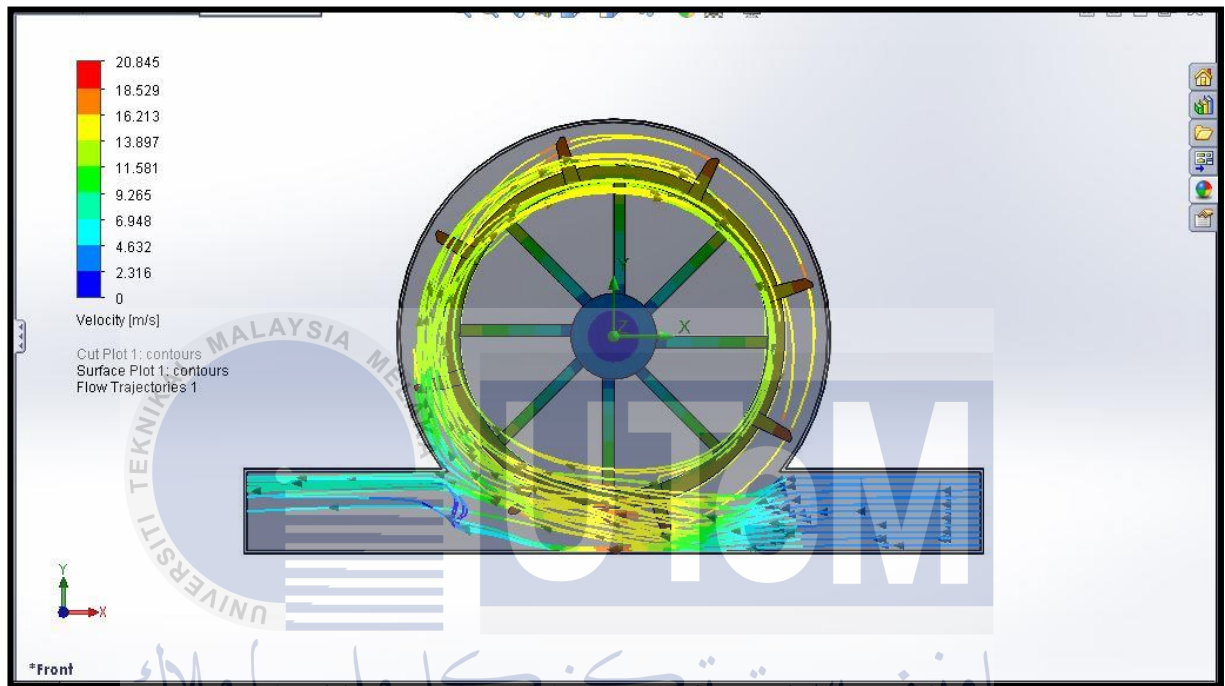


Figure 4.7: Flow Trajectories of Turbine Analysis.

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In this figure 4.8, is a cut plot velocity turbine analysis also using Dassault Systèmes SolidWorks to shows more detailed on a turbine. In this cut plot image shows how actually water is flowing in a closed space. At each turbine bucket, there are orange regions that represent higher velocity of water that flow onto it. Around the turbine, the analysis shows slightly yellow and green regions which are giving velocity range from 9.265 m/s to 16.213 m/s. While on water inlet, the velocity of water presenting from 0 m/s to 4.632 m/s which give result of dark blue color until light blue color grade. Meanwhile, from obtained data, the highest water velocity gives result of 0.224 m/s, means that it slotted the lowest velocity of water flow in this result.



Figure 4.8: Turbine Analysis of Cut Plot Velocity.

In figure 4.9. an analysis shows the cut plot pressure turbine analysis. From the water source or water inlet, high pressure appeared and flowing into the closed space. This is because of the atmospheric pressure allow the water to flow in very high pressure which represent the range from 129297.94 Pa to 157669.13 Pa and this range is labelled as a red region. For this experiment, water pressure of drainage calculation is needed which is show as below:

$$P = \rho gh \quad (4.3)$$

Where

P = Pressure (Pa)

ρ = Water Density (kg/m³)

g = Gravitational Force (m/s²)

h = Height of water level (m)

As the density of water is fixed which is 1000 kg/m³ and height of water level is 430mm, so the calculation would be:

$$P = 1000 * 9.81 * (430 * 10^{-3})$$

$$P = 4218.3 \text{ Pa} \quad (4.4)$$

With the answer given, it means that in the experiment, the pressure is in the medium state that slotted about -12558.04 Pa to 15813.16 Pa and it stated in light turquoise grade. While on the turbine bucket, the pressure on each bucket shows a quite high pressure when water flow onto it and results of range from 44184.35 Pa to 100926.74 Pa. On the water outlet of turbine analysis also giving the result of water pressure is high that is graded as greenish-yellow color to orange color and the range is about from 72555.55 Pa to 129297.94 Pa.

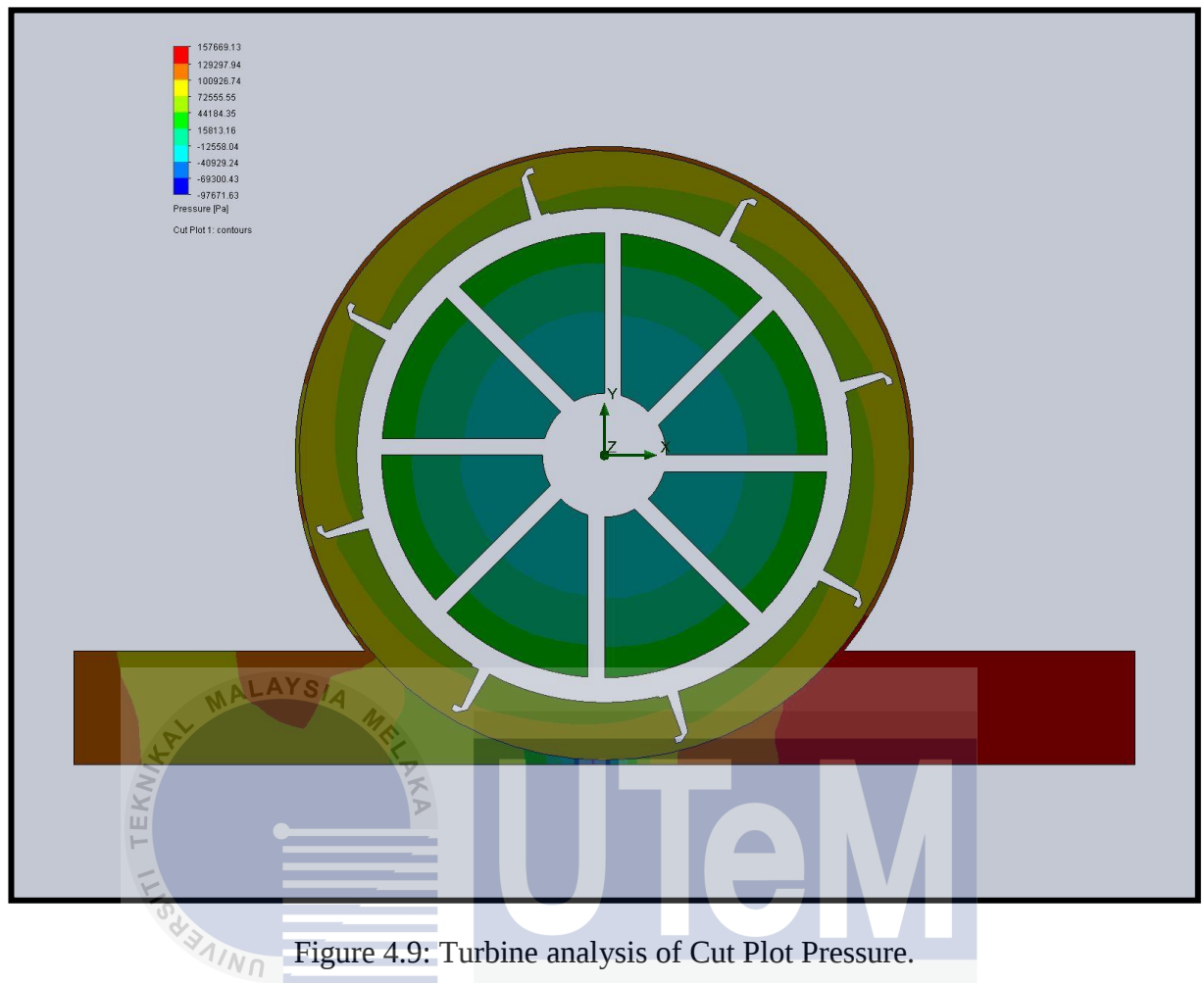


Figure 4.9: Turbine analysis of Cut Plot Pressure.

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Figure 4.10 is focused on velocity onto the surface plot turbine. This surface plot of velocity analysis is similar with the cut plot velocity analysis but this figure shows only the turbine with color grading on a turbine. As data obtained from the experiment, the highest velocity of the water is 0.224 m/s and it is slotted in dark blue region which is from 0 m/s to 2.316 m/s. Meanwhile in this figure of analysis, there are multiple grade of shaded region. The highest grade of shaded region is on the bucket which is orange shaded region where the velocity of the water hit the bucket gives the higher range of velocity which is range from 16.213 m/s to 18.259 m/s.



Figure 4.10: Turbine Analysis of Velocity Surface Plot

Pressure surface plot turbine analysis on figure 4.11 is also giving similarities with the turbine analysis of pressure cut plot but this analysis is focused on a turbine. Mostly the color shaded region show fully green colored on the round shape followed by the greenish-yellow colored on turbine bucket which are represent from range 15813.16 Pa to 72555.55 Pa and it classified as the highest pressure on the turbine. The lowest pressure on the turbine is on the center which is -97671.63 Pa.

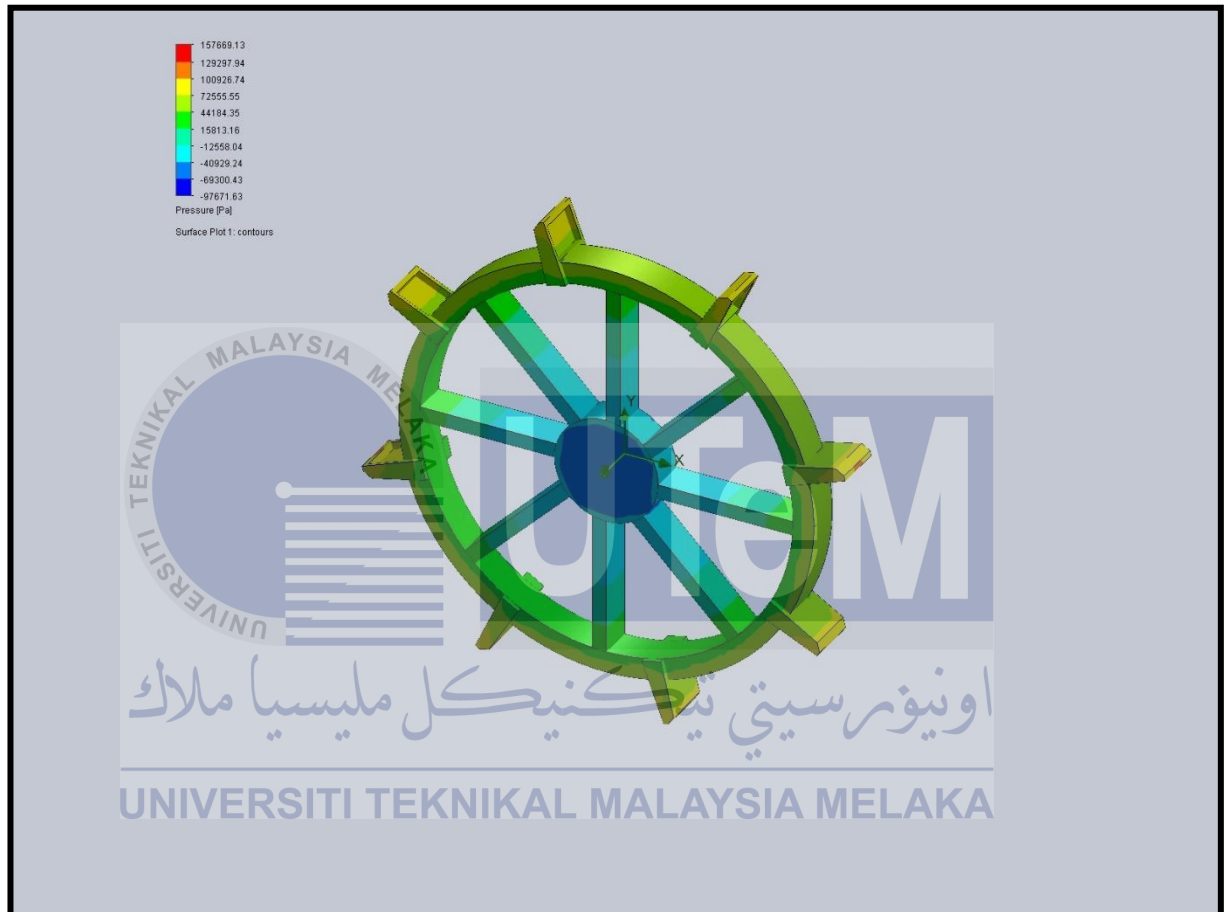


Figure 4.11: Turbine Analysis of Pressure Surface Plot

CHAPTER 5

CONCLUSION & RECOMMENDATION

This chapter is to conclude overall project of Development of Water Floating Nano Turbine based on the objectives mentioned in Chapter 1 of this experiment.

The experiment of Development of Water Floating Nano Turbine was successfully conducted. The first objective was to identify the speed of water drain. In a drainage system, a stream flow increasing when there is a degree of slope so that it is related each other to get higher speed of water drain. Next objective was to design the hydro turbine to harvest energy from water flow sources. This experiment was invented with comprising of water floater and a turbine attached with a floater for in-home purpose only. As this project was developed on drainage system, the purpose of floater is when the water level increasing, the turbine is keep rotate to harvest the energy even the water level is ascending and descending. Lastly, the objective was to identify the maximum voltage that can be generated by the turbine from the stream flow. In a conducted experiment, when the highest water velocity is identified, means that the voltage that produced is also high and it is depending on slope of the drainage system. If the drainage system level is in planar level, the result of water velocity may produce a low speed and low voltage reading.

Even though the results could not be obtained higher voltage, some recommendations may apply to this Development of Water Floating Nano Turbine which is using an additional motor to generate more voltage to the current motor. The existing motor obtained only 0.19 V during experiment is conducted. To obtain higher voltage reading, the additional motor is needed and it can be mount next to the existing motor and using a concept of pulley so that when conducting an experiment, the result of obtaining a voltage should be higher.

Next recommendation is to upgrade the mounting of both side of the floater railing. A long-treaded shaft mount the floater railing and some of drainage wall surface could not mount the floater railing properly. A long-treaded shaft should be welding at the end of shaft with a steel plate for better grip.

Other recommendation for this Development of Water Floating Nano Turbine is to do cover for the turbine motor. During conducting an experiment, a turbine motor is exposed to the water drain so that it may affect the results of obtaining a voltage. To avoid inaccurate obtained reading, a plastic cover or PVC pipe cover should enough to cover the existing motor turbine.

Final recommendation of this Development of Water Floating Nano Turbine is to extend the short wire from the turbine motor. The existing turbine motor comes only a short wire so that during conducting an experiment, a person need to bend his/her body to obtain the reading that made a person feeling uncomfortable. The extension wire is added and joint with the short wire for ease of use when obtain a voltage reading during experiment is conducted.

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APPENDICES

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