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DESIGN AND FABRICATE A WAVE TANK


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Laporan ini diserahkan kepada Fakulti Kejuruteraan Mekanikal sebagai memenuhi sebahagian daripada syarat penganugerahan Ijazah Sarjana Muda Kejuruteraan Mekanikal (Termal-Bendalir)

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ABSTRACT

This paper is described about the project of designing a simulation wave tank which will produced an experiment about a mounted device capable of converting tidal energy into electrical energy. It consists of a buoyancy where fitting to the pivoted arm where will produced a circulation motion of simple wheel model by the up and down movement from wave and drive the dynamo as a turbine to convert it to electrical energy. This motion was a combination of tidal energy and mechanical device and able to generate some power of electricity like a power plant. The project also involved with the study and observation on ocean wave especially at the shore line. The characteristics of the wave also will be determined on the experimental to make sure the differential between a real shore waves is same with the experimental. So, all the characteristics of shoreline wave behavior also were determined.

ABSTRAK

Laporan ini merupakan penerangan tentang projek merekabentuk dan memfabrikasi sebuah tangki yang mampu untuk menjana ombak di mana daripada penghasilan ombak tersebut akan digunakan untuk menggerak sebuah sistem mekanikal sebagai alat yang akan menukarkan tenaga ombak kepada tenaga elektrik. Sistem tersebut akan dilengkapi oleh sebuah pelampung yang akan disambungkan bersama sebuah rod yang akan membolehkan sistem ini melakukan pergerakan yang memutar sistem dari gerakan turun naik ombak dan akan memutar dynamo sebagai turbin yang akan menukarkan gerakan tadi kepada tenaga elektrik. Pergerakan ini merupakan suatu konsep dari gabungan tenaga ombak dan sistem mekanikal yang mampu digunakan sebagai alatan baru untuk menghasilkan tenaga elektrik di pusat janakuasa. Projek ini juga turut melibatkan kajian dan pemerhatian tentang ombak laut terutamanya di kawasan pantai. Justeru itu, sifat-sifat ombak akan ditentukan dan ujikaji melalui tangki tersebut akan dibezakan di antara ombak pantai yang sebenar untuk melihat persamaannya. Dengan itu segala maklumat dan sifat-sifat ombak pantai akan diteliti dan ditentukan.

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LIST OF SYMBOL

SYMBOLS	DEFINITION
H	Wave height
T	Period.
a	Amplitude
f	Frequency
C	Celerity
L	Wavelength
d	Water depth
k	Wave numbers
E	Wave energy
g	Gravity
t	Time
U	Velocity of exceeding wave celerity
F	Force
G	Gravitational constant
m	Mass
a	Mean radius of earth
R	Distance between earth with lunar surface
θ	Degree
ρ	Water density

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Design and fabricate a wave tank

Chapter 1

Introduction

Tidal wave was a one of new natural source which in identified to applied in produced an electricity energy. Days for days the research on tidal energy was upgraded to wide the application of it.

The basic research on tidal energy was an adaptation from the research of fluid flow where in this day life there many application stuff and design have a relation in fluid. The power of the waves is readily visible on nearly every ocean shore in the world. There has been much research to harness the power of these waves and various machines have now been developed.

These fall broadly into three categories:

- 1.0.1 Machines which channel waves into constricted chambers. As the waves flow in and out of the chamber, they force air in and out of the chamber. These air flows are in turn channeled through a specialized turbine, which is used to drive a generator. This type of machine is principally designed for use on or near the shore, or for incorporation into breakwaters. Commercially, this kind of machine is the most advanced and is particularly advantageous when incorporated into coastal protection

- 1.0.2 Fixed or semi-fixed machines which utilize the pressure differential in the water that occurs at a submerged point as the wave passes over that point. The pressure differential is used by a variety of means to cause a fluid to flow in a circuit, which is then used to drive a turbine and generator
- 1.0.3 Machines which utilize their buoyancy to cause movement in a part of the device as it move up and down in the wave. The movement is used either directly or indirectly to drive a generator.

1.1 Problem statement

In this project the effort of research is started from the statement of the problem. Every product where been produced till this time was a solution of the problem that world facing everyday. For example, the problem of connecting people has brought a many technology product now. The entire product is to create an easy way without wasting time and money.

The definition and analyze of each problem need to be clearly describe for a best solution of it without waste or get no benefit from it. From the defining problems, the solution process is started with a few procedure to make sure the solution that create from project gives a successfully results. The planning and research is the most important thing during describe about a problem analysis. This is because before the solution was made there are many things need to be considered. This consideration will be a guide for the chosen solution.

During designing a wave tank a lot of things need to be taken as a consideration. As we know, generator is a device to produce an electrical energy using a concept of turbine which has been driven with many type of source. This source was a real problem that had been facing with any developer during to consider the application, benefit and efficiency of the source.

In this world now, the application of electric energy had been large the range and become an important and critical elements in process of human life. The increasing of uses this energy is more days by days, so the government of each country needs to do an alternative solution to create another source for generate electric energy to fulfill all the energy demand of their country.

There was many kind source of energy from can be use as a power source like solar, wind, and hydro and the tidal wave is a new source where need to renew its application. Beside that, this source is very suitable for all country because the non complex construction of plant and ocean with this potential technology easily can be founded.

Before designing the tank, the characteristics of waves needs to be explore first as an additional information data. This is because the problem to simulate a water wave is very difficult where the tidal waves are a very unique natural phenomenon which to simulated in limited area.

The problem of ocean waves is on it behavior where it consists about the amplitude, frequency, force and velocity. This matter is difficult things to measure because the current research is able only do at shoreline but the real waves is different with at shoreline in criteria of size, types and forces.

This tank are been design after look at there no have any design like this tank to help the organization doing the study and research about waves. During designing this tank, the consideration on cost, material, size, operation basic concept, types of waves, forces and many more things need to be taken. So all this criteria are come from the flow of the water been produced where wave will created according on force on movement paddle on continuously.

This condition will bring an unstable frequency waves inside the tank. The material need to be ready to avoid this forces and other related effect from water such as a rust. The steel material clearly will faces with this problem but in fabricate process metal is very easy to fabricate.

From the basic principle the operation of this process is produced a high pressure of tension which able to damage the tank and paddle structure. It's also about the water mass, movement water can bring a bad effect to the tank. The force is not only on one direction but it will move to all surfaces and the failure structure of construction tank brings a bad effect.

Water wave in this tank been created by movement of paddle, this process give paddle a high pressure while faces with 2 energy from the pushing energy by operator and from the water. The critical point on this 2 pressure is happens on the paddle bar which this opposites direction forces can bring a bad cause on the paddle such as the bar broke.

The same thing also happens on the mass of the paddle where during the swing of paddle, the support of this paddle gets a high tension and can bring effect on the efficiency of paddle operation and for further bad effect the paddle support can broke.

All of this design need to accord on the cost also. The real wave tank which built by any organization to do the research is very highly costing. In this project cost is very sensitive matter.

The reducing a cost is very important thing during design and fabricate this project. So the chosen material must be able to do the operation in low cost. On that, the solution of all problem need to make in creative and simples ways. Since this project not been widely on research now, all the project procedure need to do in own ways.

On real site, tidal wave generator is built in highly cost and able to supply a large volume of electricity power but this project not doing on that. It's just only proof about this energy and all the scarcity on this project is can't be avoided.

1.2 Problem analysis

In this part the problem analysis is clearly state consists with the analyze results and solution on the problem state before. As been mention before the problem of this project is come in many type. The good consideration needs to be applied during started the design process.

The problem on find the data about wave can be find on revision and study on journal, book, website and any other source.

The theory of wave is a main of study which the theory of length, frequency, velocity and force can be defined. But the deep study on it is not necessary because the main objective of this project is only on simulation the wave, so the proof of the wave theory is just the additional information only.

When considering the material of project, clear Perspex had been chosen because this material is not only have a good strength but it's also light and the movement of wave can clearly able to look.

Perspex also has the important of criteria that needed which it haven't reaction with water and the worried of rust can be terminate. The same thing also happens on the paddle part where the surface of paddle is fabricate from sheet of aluminum which inside the construction of paddle will consist with a few bar steel with anti rust layer as the paddle support. The bar of paddle is made from steel.

This material had been choose because firstly it can resist the rust and not very heavy. The easy to fabricate also be the factor of this chosen material.

On the middle of paddle surfaces 2 holes and a cover bigger than that holes is been made to reduces the force when paddle is swing back.

The water behind the paddle will flow through front the paddle surface to increase the volume and decreased the force in inwards motion. This holes also can be describe as one way valve which it also automatically increase the water flow velocity in forwards motion of paddle.

A piece of Perspex will be attached at the middle of tank where the function is to absorb the wave or as a wave breaker. This piece will been place in slope position in suitable degree and length to break the wave naturally and slowly and the water will flow onto front space of tank.

When the water reaches some limit of level it will been flow back to the rear of tank at behind the paddle position through the pipeline which like as a drain. So this flow will produce a natural circulation while the operations still go on.

All the material of this tank is made from hard plastic so the cost can be reduces and the problem on cost can be achieve the target in low the project costing.

1.3 Design and fabricate a wave tank project

Objective

- 1.3.1 Make a simulation of ocean wave from the fabricated designed wave tank.
- 1.3.2 To study the application of ocean waves on conversion energy
- 1.3.3 Design and fabricate the suitable paddle to generate needed waves
- 1.3.4 Design and fabricate a model wave electricity generator.

1.4 Scope of Project

This project is mainly about design and fabricate a tidal wave tank where the operation is about to make a simulation of wave which this wave is using as a source to drive a mechanical device where will move the dynamo as a turbine to produced an electric energy.

This model is design to proof the wave theory about its energy as an alternative energy to drive a generator like other source as wind, hydro, engine, solar and many more.

For this project a wave tank need to design and fabricate with a full considering about characteristics of a tank which able to accept a tension of water wave where had been produced from a designed swing paddle in making a constant wave like a real wave such at the ocean.

The design a wave tank also consist with a consideration about the suitable position of paddle, model of generator, buoyancy and the structure of the model beside the design of efficient paddle which able to produced a force to make a constant wave which needed in this operation.

The transducer where is apply in this project operation to convert the mechanical energy to electrical energy is a small dynamo which attach on the model of generator where drive by a simple bicycle wheel with its gear system.

The buoyancy movement in this operation will drive the gear device and the consideration of force which been produced from this movement also need to determine to avoid a failure operation during this project.

Totally this project is more about designing and fabricating the wave tank which able to fulfill the criteria where been state at above.

Chapter 2

Literature review

2.1 Wave

The ocean wave was a natural phenomenon where the basic occurring of waves is caused by the friction of wind on water and it can be define as a water surface undulation where been generated by the energy transfer. The interactions of restoring forces from gravity and disturbing by wind were a propagating of the ocean waves.

Originally, most ocean waves generated from the wind blowing across the surface of ocean water. Waves in deep water don't affect the water below them at a depth greater than half their wavelength. Since wavelengths of wind-generated waves at sea are rarely any longer than 150 meters, water below 75 meters isn't stirred by it at all.

When the wave nears the shore, friction between it and the land slows down the wave. The wave literally piles up, becoming so high and steep that gravity causes it to fall over, or break, crashing into the shore¹.

Different with other big waves like tsunami or seismic sea wave where this waves was generated from earthquakes, marine landslide and volcanic eruptions. In the different view, the tidal or largest of all ocean waves can be describe as a result.

2.1.1 Wave classification

The classified of wave were according either from the waves pass through the body of material or move along interface. Some example of body waves is primary and secondary seismic waves and the surface waves are coming from Rayleigh waves which were characterized by an orbital motion and the Love waves.

The surfaces of wave is consists of :

Wave crest : the highest point of a wave.

Wave trough : the lowest point of a wave.

Wave height (H): the vertical distance from the crest to a trough of a wave.

Period (T) : the time it takes for one wave to pass a specified point.

Amplitude (a) : the distance a wave moves the water above or below sea level.

Frequency (f) : the number of waves passing a specified point in a time unit.

Celerity (C) : the velocity at which a wave travels.

Wavelength (L): the distance measured from any point on a wave the equivalent point on adjacent wave²

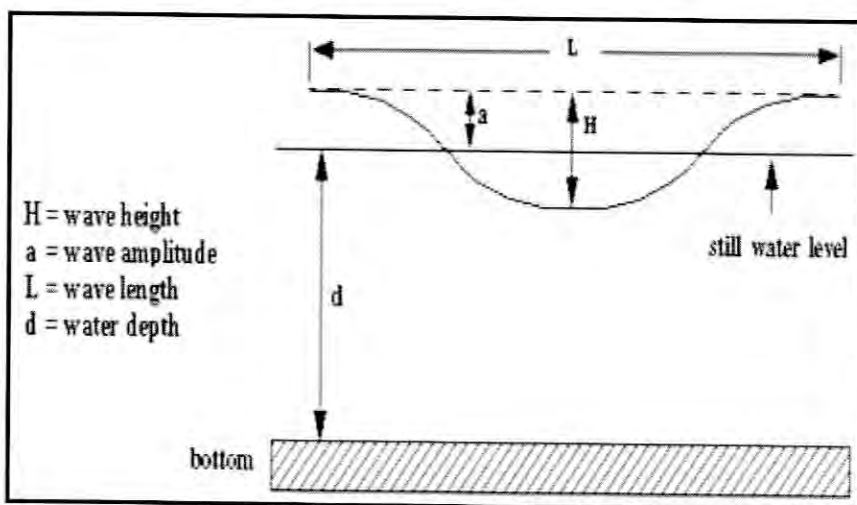


Figure 2.1 : Description of wave