UNIVERSITI TEKNIKAL MALAYSIA MELAKA

IMPROVEMENT OF BUOYANCY FOR 12 METER DOUBLE HULL BOAT USING VIRTUAL SIMULATION.

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

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DECLARATION

I hereby, declared this report entitled “Improvement of Buoyancy for 12 Metre Double Hull Boat Using Virtual Simulation.” is the results of my own research except as cited in references.

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Date : 18/1/2018

APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfilment of the requirements for the degree of Bachelor of Mechanical Engineering Technology (Automotive Technology) (Honours). The member of the supervisory is as follow:

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ABSTRAK

Bot adalah sebuah pengangkutan air yang sering digunakan untuk pelbagai aktiviti air yang merangkumi pelbagai sektor, seperti sektor pelancongan, perindustrian dan pengangkutan harian.Selain itu, setiap bot yang direka adalah berbeza bergantung kepada jenis kegunaannya. Bot yang biasa kita lihat atau kenali adalah mempunyai satu badan kapal sahaja. Reka bentuk bot yang mempunyai satu badan sahaja kebanyakkan di gunakan untuk bot-bot kecil atau perahu yang mana sesuai untuk kawasan yang sempit atau pedalaman. Namun begitu reka bentuk bot yang mempunyai satu badan adalah kurang stabil dan mempunyai daya apungan yang kurang. Bagi menyelesaikan masalah tersebut satu reka bentuk bot telah dibuat dengan membina bot yang mempunyai dua badan yang akan lebih stabil dan lebar. Boat yang mempunyai dua badan dikenali sebagai catamaran. Tujuan projek ini dijalankan adalah untuk mereka bentuk bot catamaran 12 meter yang mempunyai daya kestabilan dan apungan yang baik. Cara yang digunakan semasa menjalankan projek ini adalah menggunakan software simulasi. Semua reka bentuk yang dibuat akan dianalisis menggunakan virtual simulation wind tunnel. Hasil daripada keputusan analisis yang diperolehi akan di nilai dan reka bentuk boat 3 telah dipilih kerana nilai daya apungan dan daya rintangannya yang terbaik diantara yang lain-lain.

ABSTRACT

Boats are a water transportation that is often used for a variety of water activities that cover various sectors, such as tourism, industrial and daily transportation. In addition, each designed boat is different depending on its use. The usual boat has a single hull only. The design of a boat with only one body is used for small boats or boats which are suitable for narrow or inland areas. However, the design of a boat with one body is less stable and has less float. To solve the problem, a boat design was created by building a two-body boat that would be more stable and wide. The boat with two bodies is known as catamaran. The purpose of this project is to design a 12 meter boat catamaran which has good stability and buoyancy. Methods used in this project are reverse engineering and virtual simulation. All the designs will be analysed using the virtual simulation wind tunnel. As a result of the analysis results obtained in the value and design of the boat 3 have been chosen because of its excellent buoyancy force and drag coefficient among others.

DEDICATION

To my beloved family, friends and that accompanying me along difficult pathway in my university life, thanks for your help and support.

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First of all, thanks to Allah S.W.T. with blessings and for the strength given to me when finish this project. I would like to extend heartfelt gratitude to my supervisor, En. Mohammad Rafi Bin Omar for his advice and guidance in completing this project.

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TABLE OF CONTENT

LIST OF TABLE

LIST OF FIGURES

LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

AL - Aluminium

BCE - Before the Common Era

B - Buoyancy force in N

Cd - Drag Coefficient

CATIA - computer aided three-dimensional interactive application

CFD - Introduction of Computational Fluid Dynamic (CFD)

g - Gravity force (9.806 m/s^2)

IEC - International Electro technical Commission (IEC) standards.

LED - Light-Emitting Diode

VWT - Virtual Wind Tunnel

V - Displaced body volume of liquid in kg/m^3

ρf - fluid density in kg/m^3

3D - Three Dimension

CHAPTER 1

INTRODUCTION

1.0 Introduction of Buoyancy

Boats or ships, there is heavy with the weight of thousands of tons but it can still be floating above the water surface. But it is different with other objects that are smaller and lighter for example rocks that will sink when being in the water. The same as people, we will float when breathing in water and will sink when we exhale even our weight has not changed. This phenomenon can only be explained by scientific principle called buoyancy. Buoyancy is the force on any object in the water and compared to the weight of the object. Power to make objects float or sink. When floating objects, or objects buoyancy core is greater than the power down by heavy objects. If the density of the object is less than the density of water (1 g / cm^3), then the object will float. When an object is submerged, the weight of the object is greater than the upward buoyancy force exerted by the water. The density of the object is larger than (1 g / cm^3) .When the object is in a state of drift balanced not float or sink it means the object is equal to the buoyancy west. When the object is in a state floating on water density neutral object is equal to the density of water. Neutral Buoyancy is a very important principle in competition sea perch. Similar in principle submarine submerged in the water you want but do not drown in the sea. The Archimedes principle of buoyancy ascent is equal to the weight of the fluid displaced. Floating Force = Weight Fluid Displaced. This can also be explained by Newton's second law, which states that every action has a reaction equal and opposite.

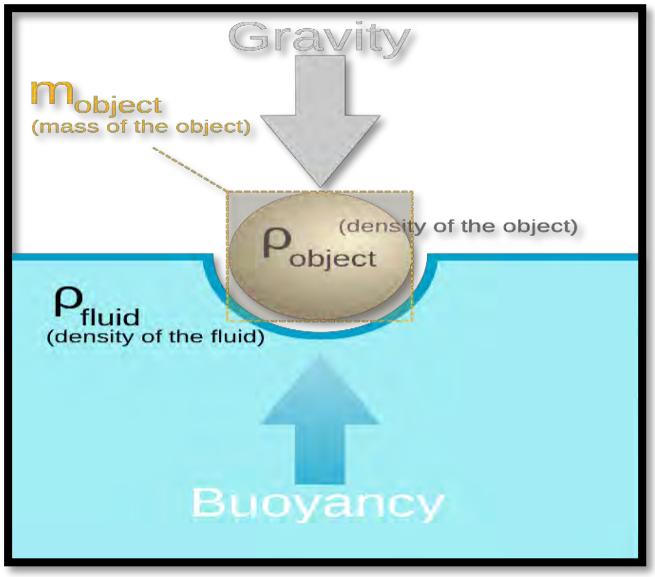

Figure 1.0: Buoyancy

1.1 Stability

Stability of an object is when he is in a stable state of equilibrium when the object is in a state of balance between opposing forces. The Stability is the ability of an object to created forces to return the object in the original condition. Buoyancy of an object is at the centre of the float. It is the same as the centroid of the displaced fluid. This is caused by the gravitational force acting on an object at the centre of gravity of the object. Each of the actions must be equal and opposite and thrust nut must be at the centre of gravity. Heavy sea perch also occurs in the centre of gravity and if the two eyes do not line up vertically then you will rotate sea perch and unstable. The submarine ballast tank system is used to control the buoyancy of the submarine. Ballast tanks serve for submarine diving seabed, it works by pumping water into the tank to increase the mass of the ship. In addition, the water in the ballast tanks will be pumped out to allow the submarine floating on the water surface.

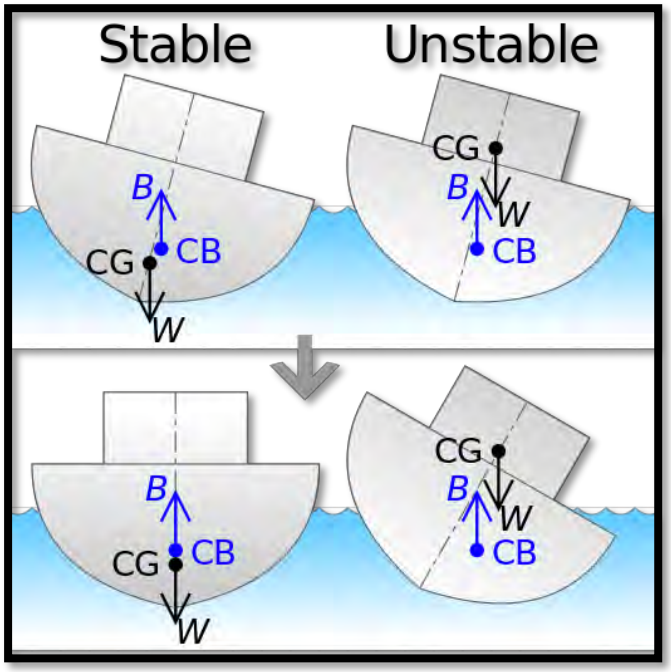

Figure 1.1: Stable and Unstable

1.2 Problem Statement

The main problem is that it is a tendency catamaran boat upside down when the wind pressure on the sail that overcomes the stability (Stevfani, 1960). This problem occurs due to the buoyancy and stability of the boat is low. Such problems will cause a great impact on passengers, crew and ship owners. For example, sinking ship will be claimed the lives of passengers and crew. Moreover, such an accident would also be detrimental to the owner of the boat itself because of the cost to repair, build and pay compensation to passengers is high. To solve of this problem, the design of the boat hulls must be designed with high of stability. Each design factors that affect the float will be reviewed in order to produce a good result buoyancy and stability. During this project in BRAZEN COMPOSITE data a 12 meter catamaran boat was taken using a 3D scanner to analyse. Another issue during this project is a size 12 meter catamaran boats too large. It is difficult to scan the entire boat for a boat data existing in the industry. The CAD data of the existing boat will be analysed by using HYPERWORK and CFD simulation to get the result of buoyancy. The new design of catamaran boat hulls will be created and compare with existing result of simulation for the improvement.

1.3 Objective

The objective of this project are:

1. To perform the buoyancy analysis on the 12 meter double hull boat.
2. To improve the buoyancy and stability of 12 meter double hull boat due to the hull design using virtual simulation wind tunnel

1.4 Scope

This project is about the buoyancy of the catamaran boat that has two hulls. The 3D scanner will be used to scan the existing body of catamaran boat and convert from POLYWORK to CAD data. The CAD data will be analysed with CFD software to obtain the buoyancy stability data. Based on the existing result will be improved as a new design. The new design of these boats will be created and analysed by USING ALTAIR WINDTUNNEL V14. The best result of buoyancy and stability of the design will be selected at end of this project. All the new designs of the catamaran boat must in a range of 12 meter.

CHAPTER 2

LITERATURE RIVIEW

2.0 Introduction

Literature is a process to review and explore to help process the introduction of new techniques for the design and analyse the shape of the hull. Through this process, all service information and detailed background studies related matters will be published. Each service information published will be understood by the authors to get a little overview and guidelines for the success of this analysis. Among the aspects involved in this research is the theory of buoyancy, stability, 3D scanners and simulations. All these aspects is essential for achieving the objectives of this project.

2.1 History Background

A boats are designed to float and water are used to perform work or as transport over water. Small boats usually used on inland waterways in areas such as lakes and rivers or coastal protected area. However the boat as the ship has been designed for use as a boat in the sea to catch a whale that has been designed for the operation of vessels in offshore environments. Terms of the navy, the boat is a small boat that can be carried on other ships.

Bot has a variety of shapes, sizes and construction methods. Differences ships and boats is based on body size, shape and number of cargo or passenger capacity. Boats usually have a smaller body than the ship. In addition, there are also boats that used manpower to be moved (e.g., rowboat). Boat normally used by the ancients as the transport of water, it is small and suitable for narrow areas. In addition, there are also

boats that use wind energy, namely sailing boat movement is based on wind speed. The boats that are installed today are using motor power using petrol or diesel fuel. This is because this type of motor or engine are produce more power for a speed and more advance. Additionally, there is also a boat that can be used on land and on the water surface, known as a hovercraft.

Moreover, the boat have a two type for a body design. The type is single hull and Double hull. The single hull is a common bot that we found and used. The double hulls is also known as catamaran boat. This boat are designed for more stability and it's commonly designed for speed boat. The Gunter Ulrich (1978) say Methods for the re-righting of a capsized cruiser catamaran are known, one of which provides a buoyancy device in bridge-deck of the catamaran lying on its side. The masthead which prevents complete capsizing of the cruiser-catamaran. An A-frame is provided at the centre of the lower. In the present state of the art at the time of the construction of the hull is a composite material consisting of a layer of glass fibre thermoplastic layer. Fiberglass is a combination of several different materials such as polyester, vinyl ester and epoxy. This material will produce a lightweight but strong material and lower cost compared to building materials others. Making process hull using this method is more efficient and can produce high quality. Every designed boat will be reviewed prior to generating stability and buoyancy of a boat that is very good. Using computational fluid dynamics (CFD) analysis method, we can produce a product design that has the characteristics required to be within a quick and cost less. Below is a picture of the types of boats available in the market.

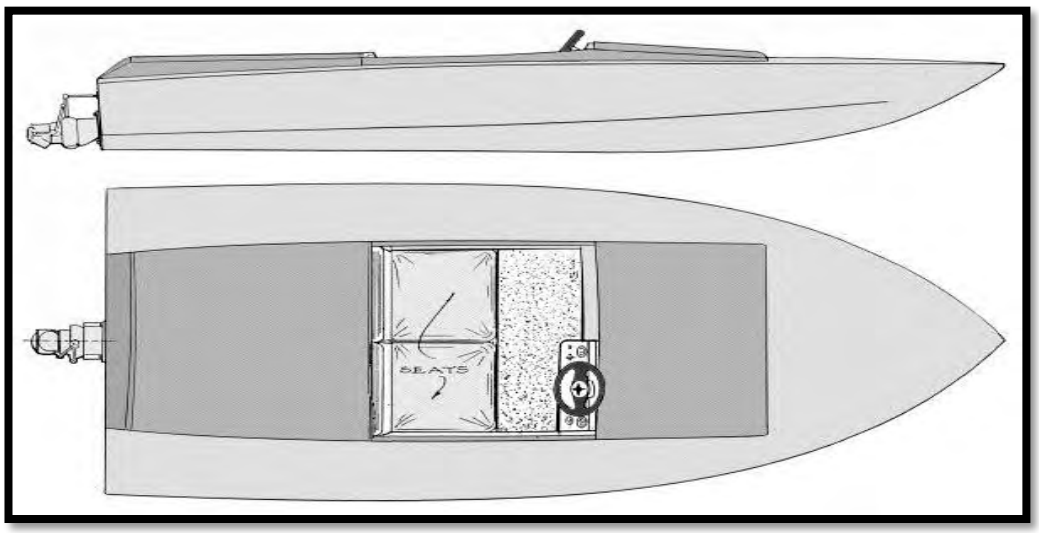

Figure 2.1: Single Hull Boat Drawing

Figure 2.2: Single Hull Existing Boat

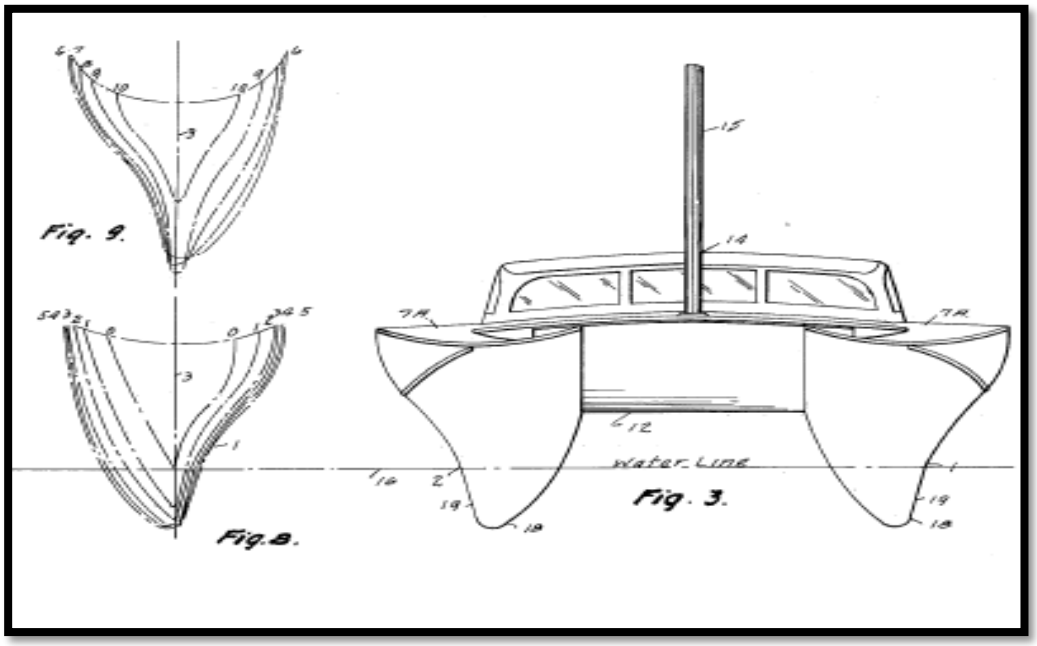

Figure 2.3: Catamaran Boat Drawing

Figure 2.4: Existing Catamaran Boat

2.2 History of Boat

According to Jean Vaucher (2014), History of the discovery of the world's oldest boat is a canoe pesse 3 meters, approximate age or the date it was built is around 8000BCE. But the craft complex have existed earlier. One carved in stone have been found in Azerbaijan dating from 10000BCE shows a bamboo boat rowed by 20 paddlers. However, there are others say that kayaks have been used in northern Europe as early as 9500BCE. However, sea-worthy boat that may have been first built before that, about 800,000 years ago not aunt by man but by his predecessor homo erectus, smart naked ape. Erectus beginning at 1.8 million years ago in Africa and its species flocks for over 1.5 million years before being replaced by our own Neanderthal and Homo sapiens. Erectus was living in an ice age (S). Moreover, in the mid-19th century, built boats are based on natural materials. In Britain and Europe wood is a natural material most widely used for building large boats for commercial and industrial revolution steel. In the 20th century aluminium has been known because it is lighter and easier to work than steel. Around 1960, a boat made of glass-reinforced plastic was introduced, better known as fiberglass. Fiberglass is a composite material consisting of fine glass fibres as reinforcement agents. Polymer agents such as fibre-reinforced polymer (FRP or fibre reinforced polymers) or glass reinforced plastic (glass-reinforced plastic or GRP), better known as "fiberglass". In the field of