UNIVERSITI TEKNIKAL MALAYSIA MELAKA

IMPROVEMENT OF 12 METER CATAMARAN BOAT HULL DESIGN

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

by

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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's in Mechanical Engineering Technology (Automotive Technology) (Hons). The member of the supervisory is as follow:

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MOHAMMAD RAFI BIN OMAR

(Project supervisor)

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Ir. MOHAMAD HAFIZ BIN HARUN

(Project advisor)

ABSTRAK

Terdapat banyak jenis bot dalam teknologi pembuatan bot. Untuk mengoptimumkan reka bentuk badan kapal, ia melibatkan pemilihan bentuk bot, algoritma optimum, huraian geometri permukaan kulit kapal, program CFD yang boleh dipercayai, merekabentuk pembolehubah dan ketepatan. Antara semua cara ini, kejuruteraan songsang mampu menawarkan kaedah yang terbaik untuk mendapatkan data reka bentuk bot. Kaedah pengimbasan menggunakan mesin laser kualiti tinggi yang mempunyai kebolehan untuk ekstrak objek fizikal dan mengubah data ke dalam satu CAD data. Dengan menukar data pengimbasan kepada CAD data, lukisan teknik bot akan dapat dihasilkan. Sebarang pengubahsuaian pada rekaan bot serta penelitian prestasi bot boleh dijalankan dengan menggunakan data teknikal bot. Di Brazen Composite , terdapat katamaran 12 meter bot yang telah dihasilkan. Bagaimanapun , bot ini tidak mempunyai data teknikal yang berkaitan dengannya. Lukisan teknik diperlukan oleh syarikat itu untuk memenuhi keperluan bidangkuasa pengangkutan air untuk permohonan permit dan juga digunakan untuk melakukan peningkatan reka bentuk badan kapal. Terdapat beberapa kaedah semasa melakukan satu kejuruteraan songsang. Ia berdepan dengan menukar data, menggabungkan data, mencabut semula menggunakan reka bentuk permukaan, mencabut semula menggunakan permukaan subbahagian dan mencabut semula menggunakan reka bentuk bahagian. Kaedah ini akan memberi kesan yang berbeza melalui analisis hidrodinamik tiga model reka bentuk badan kapal bot yang merupakan Model A, Model B and Model C. Walaubagaimanapun, melalui projek ini rekabentuk badan kapal bot Model C mempunyai satu peningkatan lebih baik melalui pendekatan rekabentuk untuk mengurangkan daya seretan reka bentuk badan kapal bot. Selain daripada mengeluarkan data teknikal, ia juga berdepan dengan asas hidrodinamik dalam keadaan keseimbangan dan kestabilan badan yang terapung.

ABSTRACT

There are many types of boat in boat manufacturing technology. To perform the hull design optimization, it involves selection of boat application, optimal algorithm, geometric description of ship hull surface, reliable CFD program, design variable and constrains. Among all these methods, reverse engineering involved scanning method offer better ways to obtain the boat design data. Scanning method requires high quality laser machine that capable to extract physical object and change the data into a CAD data. By converting the scanning data to CAD data, technical drawing of the boat can be produced. Any improvement on the boat design and performance can be performed by using boat technical data. At Brazen Composite, there is a 12 meter catamaran boat produced. However, the boat has no related technical data. The technical drawing is needed by the company to meet the requirement of the water transportation authority for permit application and also used for hull design improvement. There are several methods when doing a reverse engineering. It deals with converting the data, combining the data, redraw using surface design, redraw using subdivision surface and redraw using part design. This method will conduct to different result of hydrodynamic analysis of three model of the boat hull design which is Model A, Model B and Model C. However, through this project the Model C of boat hull design have a better improvement in design approach in order to reduce the drag force of the boat hull design. Instead of producing technical data, it also deals with basic ship hydrodynamic with the conditions of equilibrium and initial stability of floating bodies.

DEDICATION

Every challenging work needs self-efforts as well as the guidance from the elders. Those who have lending their hand to help me, such as my friends, along with all hardworking and respected lecture especially my supervisor. Not to forget, my humble effort I dedicate to my sweet, loving and supportive father and mother for their support, love, encouragement and prayers of day and night until I am able to get such a success and honour.

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LIST OF ABBREVIATIONS AND SYMBOLS

CAD	Computational Aided Drawing
CFD	Computational Fluid Dynamic
DREA	Defence Research Establishment Atlantic
Cd	Drag coefficient
Cl	Lift coefficient
Cp	Pressure coefficient
Cc	Cross coefficient
m	meter

CHAPTER 1
INTRODUCTION

1.0 Introduction

As soon as it comes to marine transport, it can be characterized into three main categories that generally constructed and commercialized. The three foremost classification of marine transportation are submerged hull, mono-hull and catamaran (Odd, 2005). These dissimilar groupings of boat or craft absolutely come with diverse form and design, constructed on their usage and the capability. Design constraint consists of such stuffs as constancy curvatures and steadiness forms (Thomas, 2006). In the characteristic of a boat design, one of the standards that affect the boat constancy is the buoyancy force as shown in Figure 1.1. For the stability of a immersed body, the physique's center of gravity must be straight lower the center of buoyancy. If the two points concur, the immersed body is in impartial equilibrium for entirely situations (Giles, Evett and Liu, 1994). This buoyancy force or hydrodynamic encouragement is appropriate significant in directive to create the boat not only balanced on water, but unwavering as well as presented in Figure 1.2 which is Illustration of buoyancy.

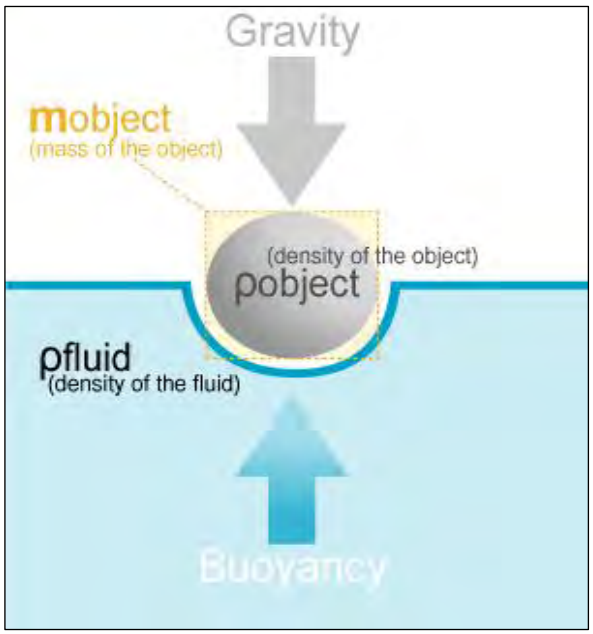

Figure 1.1: Illustration of buoyancy

From the studies, the restraint that can be correlated to this project is to decrease the wave resistance in term of hydrodynamic for 12 meters catamaran double hull boat. The purpose of this project is to determine the best hull design in term of the reducing wave in hydrodynamic for the 12 meters catamaran double hull boat. Initially, the original data will be obtained from the 3D scanning process. Then the 3D scanning data will be analyses using the Computational Fluid Dynamics (CFD) software to identify the wave flow of the boat. Some modification on the boat design will be performed in order to improve the resistance of hydrodynamic of the boat. Figure 1.2 shows the constancy of buoyancy principle.

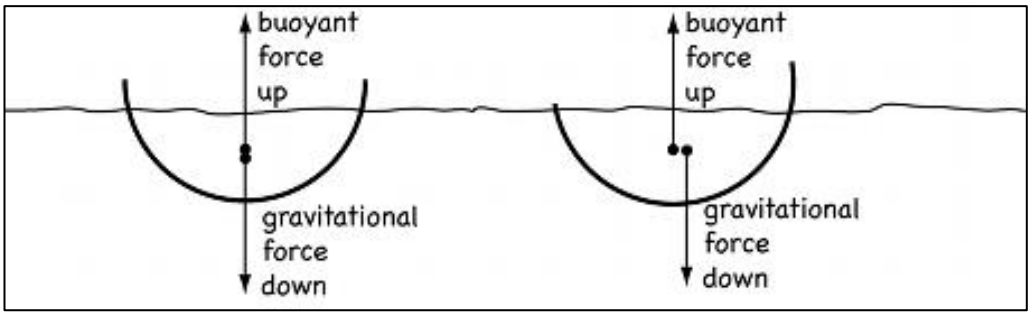

Figure 1.2: Constancy of buoyancy

1.1 Background Study

In the conservative craft strategy the wave-inflamed conveyance actions, hydrodynamic powers and auxiliary responses are evaluated forthrightly or in an indirect method by spread over the straight possible watercourse hypothesis, principally the strip hypothesis. With the emerging passion for hasty monohulls and catamaran, this framework approach has been experienced to a more remarkable degree. The linearity statement of tiny ship actions in veneration to the wave apparent is mistreated at the forepart sector of utmost rapid ships even in straight deep-sea conditions. This violation, composed with the V-shaped cross area of the ship structure in that region, will existing striking nonlinear influences in the hydrodynamic powers, nevertheless the hurl and pitch potency be predicted countless by through hypothesis. A development of loose minute in individually largeness and reappearance is single of the consequences. It could carry almost risky basic damage, for sample, the embracing of the principle surface, and it will similarly weaken the exhaustion life of base constructions. In this method, the estimate of nonlinear hydrodynamic powers and elementary feedbacks is life-threatening to the welfare of ship constructions.

All about that truly substances all watercrafts are fluctuations or extrapolations of historical illustrations. With the method of computer aided design plot out for load vessels and watercrafts, there is a desire to duplicate colossal processes of these time attempted systematizes as 3-dimensional surface models to use as references or beginning shapes. For others, notwithstanding, the objective is to go over a dazzling diagram on the computer aided design for study purposes or to make a copy of the vessel. The customary lines drawing approach by hand required the originator to both make reasonable bends, for example, stations, waterlines, backside or diagonals and to ensure that the bends coordinated up to each other in the three primary drawing sees which are Profile, Plan, and Section. As a rule, be that as it may, one will discover when examining lines drawings in books that the bends may look smooth and reasonable, yet the lines don't concur precisely in the three perspectives.

Despite the fact, the study of boat shape analysis has been done in the forgoing years, these studies are carried out with different approach. The purpose of this study is to develop a purpose design in order to reduce hydrodynamic resistance of the catamaran boat hull. There are a few steps are necessary which is scanning the catamaran to undergo the shape hull design, acoustic analysis based on hydrodynamic parameters to determine the wave resistance of boat on the water resistance. These steps can be held by using Steinbichler 3D Scanner, Catia V5 and Hypermesh for the analysis of geometry, hydrodynamic resistance and buoyancy of the boats. The hydrodynamic resistance considerably by changing the hull design in term of improvement the previous design. Hence, accurate representation of the design is essential in the simulation models used for predicting the optimal wave form of the boat above the water.

1.2 Problem Statement

Nowadays, the license for water transportation from authority issue became important. At Brazen Composite, there is a 12 meter catamaran boat manufactured. Though, the boat has no related technical data. The boat's hull and deck, for instance, are fabricated of multiple layers of fiberglass with sandwich core production reinforcements. As with all fiberglass construction, Brazen Composite first builds molds on which to shape the fiberglass parts. Molds are made of tooling fiberglass founded on a high-density foam master part. For each boat model, the company builds approximately 10 molds that last for the lifespan of the model, characteristically three or four years. During that time, the molds are often changed. This occurs when a modification is made to facilitate production or to meet a marketing necessity. Present molds also are changed to spin off new models, such as the 12 meter catamaran boats mold in recent times presented. Whenever molds are modified, Brazen Composite must update the manufacturing process to reflect the changes. The best way to acquire shape data is to import a CAD model of the part.

An up-to-date CAD model is not available; however, Brazen Composite is working with molds that have been transformed manually. From the condition Brazen Composite requires reverse engineering to capture the new shape. The scanner and the software provided with it make it possible in minimal time to generate a CAD model of the scanned part that faithfully duplicates the original part. The software also can be used to compare the original design geometry to the actual physical part, generating an overall graduated color error plot that shows at a glance where, and by how much, surfaces deviate from the original design. This goes far beyond the dimensional checks that can be performed with Catia V5 software. Instead of producing technical drawing, the CAD model can perform an improvement of the boat hydrodynamic resistance performance on the water by modifying boat hull design. The design can be analyze by using Hypermesh and Virtual Wind Tunnel software. By using this software, the boat resistance can be determined. Hence, the amount of the hydrodynamic resistance can be calculated. Henceforth, this simulation will help to reduce the boat resistance across the water drag.

1.3 Objectives

The objectives of this project are:

a) To produce 12 meter catamaran boat technical drawing through the reverse engineering method.
b) To improve the boat hydrodynamic resistance performance on the water by modifying boat hull design.

1.4 Work Scope

In this task, it covers several work scopes which will be followed to complete this project accordingly. The work scopes of this project are:

a) Scan existing 12 meter catamaran boat at Brazen Composite by using 3D scanner.
b) Converting scanning data to CAD data by using Polyworks.
c) Produce technical drawing by using Catia V5 software.
d) Analyzing hydrodynamic resistance boat hull design using Hypermesh software.
e) Improving the boat design in term of hydrodynamic resistance performance on the water.

1.5 Significant of Project

The purpose of this study is to produce 12 meter catamaran boat technical drawing through the reverse engineering method and to improve the boat hydrodynamic resistance performance on the water by modifying boat hull design. There are a few steps are necessary to perform the hull design optimization. It involves selection of boat application, optimal algorithm, geometric description of ship hull surface, reliable CFD program, design variable and constrains. Among all these methods, reverse engineering involved scanning method offer better ways to obtain the boat design data. It deals with converting the data, combining the data, redraw using surface design, redraw using subdivision surface and redraw using part design. This method will conduct to different approach to find the better design of the boat hull.

Hence, the accurate data can be representation in the CFD analysis. Thus, it is believed that the outcome of this project will give a new contribution in the marine industry in terms of improvement of boat hull design analysis. This project will contribute a better design of boat hull to give a better impact for the boat hull design.

CHAPTER 2
LITERATURE REVIEW

2.0 Introduction

This section will cover the background study on the project based on the knowledge and information required to design and develop the project. Literature is a progression to review and explore to assistance process the introduction of new techniques for design and analyse the shape of the hull based on the past researches. To develop this project, it is essential to go over numerous researches that are related to the idea of this project. These researches will emphasis on the hardware and software that will be used in doing this project. With this project, it will help in achieving the idea of the project based on what method is suitable to use. In the company of the aspects involved in this research is the theory of buoyancy, stability, 3D scanning and Computational Fluid Dynamics (CFD) simulations. The source of these researches has to be acceptable in the system format such as books, journals, articles and website that are licensed. Following, methods and tools used to do this project are described and deliberated.

2.1 Marine Transport

Transport is a movable mechanism that castoff to carriage persons or belongings to the chosen place. A marine transport or the further name watercraft water-borne transport which is the transport that able to be used on water such as pond, river, even at the sea. This marine transport are contains ship, boat, hovercraft,