

**DESIGN ANALYSIS AND BUILT A PTOTOTYPE OF HUMAN POWER  
SUBMARINE**

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**This thesis is submitted to the Faculty of Mechanical Engineering  
In partial fulfillment of requirement for the degree  
Bachelor of Mechanical Engineering (Design & Innovation)**

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**MARCH 2007**


**DECLARATION**

“I hereby the author, declare this report entitled “DESIGN ANALYSIS & BUILT A PROTOTYPE OF HUMAN POWER SUBMARINE” is my own except for quotations and summaries which have been duly acknowledge.

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**DECLARATION**

“I hereby declare that I have read this thesis and in my opinion this thesis is sufficient in terms of scope and quality for the award of the degree Bachelor of Mechanical Engineering (Design & Innovation)”

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Date : 8 MEI 2007

## **DEDICATIONS**

To beloved father Yusoff b. Nordin, mother Hamidah Bt Shaari and family, to my supervisor En. Shamsul Anuar b. Shamsduin and friends.

Thank You for the motivations and support.

## PROJECT SUMMARY

*This is the new concept of human power submarine that can be dive in water. It gives high performance and the features solely using human power. The concepts that created are easy simple and not complicated but still can works properly. The concepts are improved time by time and lastly give some final touch to make it competitive and practical.*

*I tried to modify existing submarine to make it more competitive. I still using basic concepts of mechanical functions of existing submarine but make it grander by using human power specification. The high performance aspect is the main objectives for this design.*

## ACKNOWLEDGEMENT

First of all I would like to thanks to my PSM supervisor, Mr Shamsul Anuar bin Shamsudin, supervisor and the most important person who give me fully trustworthy to run this project. He is the person who guide me and give an encourage advise through all aspect during this project. He teaches me on how to get an idea and the flow of this project progression. Without his advice and attention, this project will be nothing at all.

I also would like to give a special thanks to Mr. Rizal Md. Tasliman for his knowledge and supervision during my interview with him. This person gave me lot of his experience and guides me on basic knowledge of submarine and standards in vessels and tanks.

Also I would like to impress my grateful to both and my beloved parents especially my father Yusoff bin Nordin nad my mother Hamidah bt. Shaari who was giving me the support to go on further with my study and completing this final project.

This lead me to successfully completed my projects Not forgotten, lot of thanks to all individual who involve and support me such Mr Liew Chee Huat(Toyo Engineering & Constuction Sdn. Bhd and Mr Ahmad Rivai(KUTKM) and En. Zakaria and all my beloved friends.

Acknowledgement

## ABSTRAK

Rekabentuk dan analisa tentang kapal selam berkuasa manusia ini telah dilakukan sejak awal lagi. Kapal selam adalah salah satu teknologi tercanggih manusia. Tidak lama dahulu pasukan polis laut berkerja secara keseluruhan di atas air, oleh itu laut menjadi salah satu medan penting bagi pengangkutan. Projek ini bertujuan merekabentuk dan menanalisa kenderaan bawah air yang menggunakan tenaga manusia sepenuhnya. Saya akan memilih rekabentuk yang terbaik yang dapat menghasilkan laju maksima dan selamat untuk beroperasi. Mekanisma yang sesuai untuk mendapatkan pergerakan terbaik dalam air juga mesti direka. Untuk merealisasikan kapal selam ini pelbagai aspek akan diambil kira dalam memastikan kurangnya daya gesera, dan mudah untuk dikendalikan. Mekanisma yang mudah tetapi memberi impak yang besar.

Abstract

## ABSTRACT

Design and analysis of human power submarine is one of the underwater vehicles that develop from early century. Submarines are incredible pieces of technology. Not so long ago, a naval force worked entirely above the water; with the addition of the submarine to the standard naval arsenal, the world below the surface became a battleground as well. This project will intended to design and analysis this underwater vehicle using solely human power. I will to choose a shape that will provide the best possible speed, yet be safe for the diver operating the submarine. The construction of the submarine must be such that it is safe to operate underwater by the diver. A propulsion system must be chosen that will efficiently propel the submarine to its top speed. A means of controlling the submarine must also be designed so that it does not cause too much drag, yet be design to effectively allow the submarine to be maneuvered easily. A simple mechanism is used to reduce the cost but high effective product.

Abstract



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Fiber glass materials

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## CHAPTER 1

### INTRODUCTION

#### 1.1 Project Background

Submarine projects are as complex as the most advanced aircraft, and they carry so much technical uncertainty that cost overruns are always a real risk[6] The word submarine was originally an adjective meaning "under the sea"[2] "Submarine" as a noun meaning a submersible craft originated as short for "submarine boat" and older books such as Twenty Thousand Leagues Under the Sea[3] always use this term.

My objective is to design Human Power Submarine. My projects are intended that the will concentrate on each of six areas of the design process such as safety, innovation, design, construction, operation and overall Engineering

By following the outline above I will be able to design and build a flooded submarine whose power is provided solely by a human. I will choose a shape that will provide the best possible speed, yet be safe for the diver operating the submarine. The construction of the submarine must be such that it is safe to operate underwater by the diver.

A propulsion system must be chosen that will efficiently propel the submarine to its top speed. A means of controlling the submarine must also be designed so that it does not cause too much drag, yet be design to effectively allow the submarine to be maneuvered easily.

There are three key parameters to consider when designing a competitive hull for the human powered submarine. The parameters are: minimal frontal area, minimal internal volume, and minimal boundary layer separation. To begin the design I choose to model the submarine using CATIACAD. Buy utilizing the CAD modeling package each

prospective hull shape could be analyzed. CATIA CAD will calculate the pressure in the hull in order to prevent from damage. Using these numbers combined with mathematical formulas the hull performance was analyzed.

## **1.2 Project Objectives**

- i. To understand the design human power submarine
- ii. To design the human power submarine
- iii. To analysis the human power submarine
- iv. To fabricate the human power submarine prototype

## **1.3 Scope of the projects**

- ❖ To understand the design of Human Power Submarine
- ❖ To do literature reviews
- ❖ To dealing with the interaction between the hull strength of the Submarine when pressured applied.
- ❖ Make a research about the suitable submarine system for the design
- ❖ Learn to use suitable software for design and analysis the Human Power Submarine
- ❖ To choose the suitable concepts about diving, surfaced, and buoyancy effect.
- ❖ To design the prototype
- ❖ To built the prototype.

### 1.4 Project Process Flow Chart for PSM 1 and PSM 2

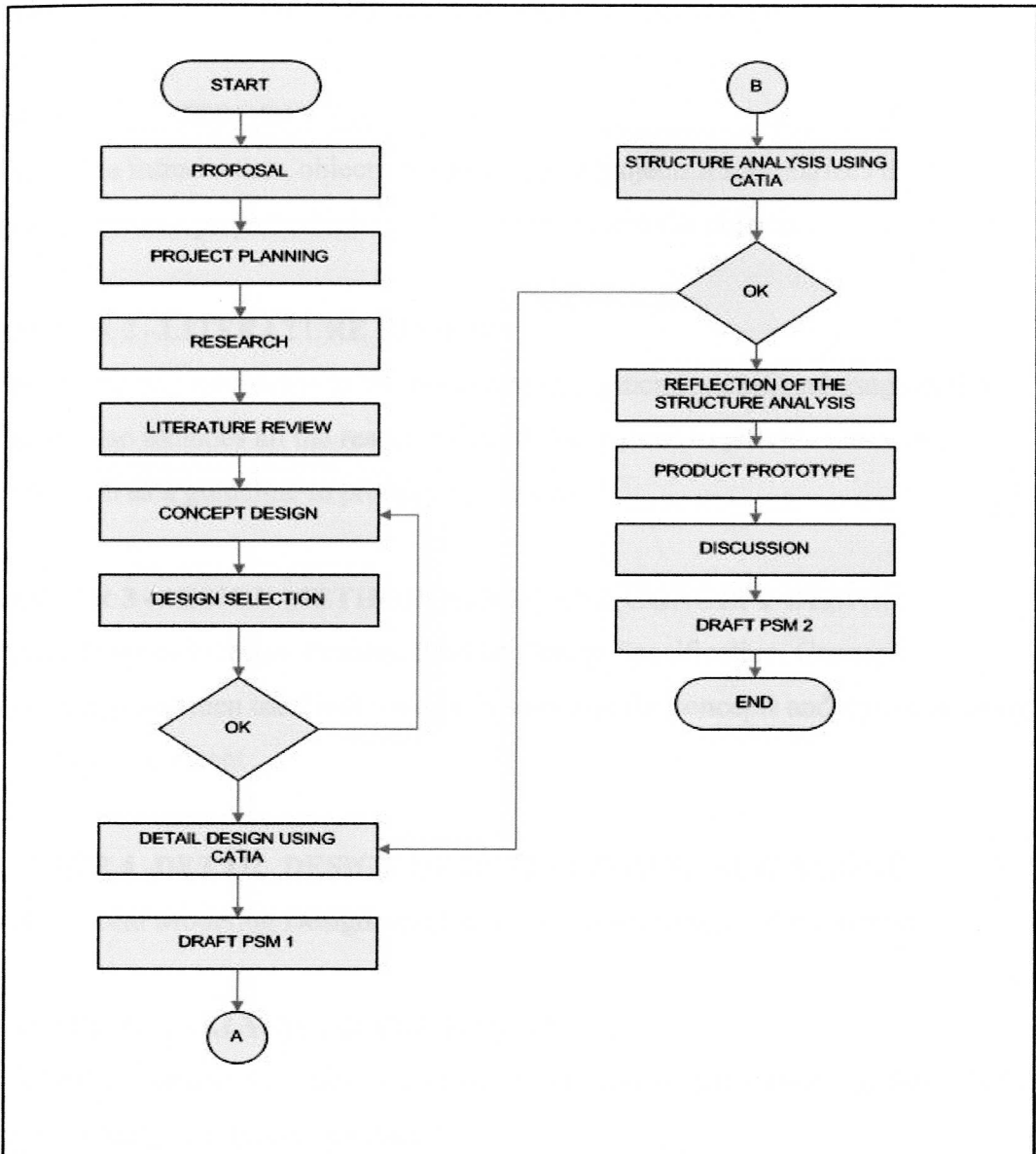


Figure 1: PSM Flow Chart

## **1.5 Structure of project**

In this part will summarize all the chapters contain in this first draft.

### **CHAPTER 1 -INTRODUCTION**

Focus on the introduction, objective, and scope of project. It summarizes the basic information about project which will be performed and the objective of this project.

### **CHAPTER 2 –LITERATURE RIVIEW**

Focus on existing submarine in the world history, principles used and usage in the military. Also includes all the research that has been done to provide ideas and specification as a guideline to produce the design.

### **CHAPTER 3 -DESIGN METHODOLOGY AND CONCEPT DESIGN**

Focus on Proposed Design Process, Product Design Specification, Concept Development and then the Final concept in selecting the concepts and the detail design of the selected concept

### **CHAPTER 4 -DETAIL DESIGN OF HUMAN POWER SUBMARINE**

Focus on Solid Modeling Design, and Features and advantages of the design.

### **CHAPTER 5: ANALYSIS OF THE DESIGN**

This chapter contains the analysis and some calculation that perform to differ between the experimental and theoretical data.

### **CHAPTER 6: CONCLUSION AND RECOMENDATION**

This is the final chapter for the thesis which contains the conclusion of this project and the recommendation for the future work for this project

## **1.6 Summary**

This chapter explains the background of the projects, project objectives, and scope of the projects and the flow of the projects. The background of the study briefly explains the meaning of the submarine and the history of submarine until the latest technology involved. Several objectives has been set in analyze and study the design of the human power submarine. This chapter also overall flow of the projects to fulfill the objectives.



## **1.6 Ringkasan Bahagian 1**

Bahagian 1 merupakan pengenalan kepada projek yang menerangkan tentang latar belakang projek, objektif projek, skop projek dan juga jadual perancangan perjalanan projek. Latar belakang projek menerangkan tentang sedikit sejarah tentang pembangunan kapal selam maksud kapal selam yang sebenar sehingga pembangunan pada masa kini yang memerlukan kapal selam yang berkemampuan tinggi untuk melakukan pelbagai misi/tujuan. Beberapa objektif telah ditetapkan untuk dicapai antaranya memahami rekabentuk kapal selam, merekabentuk kapal selam dan menjalankan analisa dan kajian berkaitan kapal selam yang direkabentuk. Bahagian 1 ini juga menerangkan secara ringkas rajah perjalanan projek untuk mencapai objektif yang telah ditetapkan.

## CHAPTER 2

### LITERATURE REVIEW

#### Chapter 2: An Introduction of Human Power Submarine

##### 2.1 Definition of Human Power Submarine

For the purpose of this Project, a submarine shall be defined as a free flooding (liquid-filled) vehicle that fully encapsulates the occupant and operates entirely beneath the surface of the water. The vehicle may carry one or two occupants. [2]

##### 2.2 History of Submarine

David Bushnell's *Turtle*, the first American submarine [10] built in 1775; its intended purpose was to break the British naval blockade of New York harbor during the American Revolution. *Turtle* was powered by a hand-driven propeller. The operator would submerge under the target, and using a screw projecting from the top of *Turtle*. This 1875 drawing by Lt. Francis Barber is the most familiar rendering of *Turtle*. [7] However, it contains several errors, including internal ballast tanks and helical screw propellers.

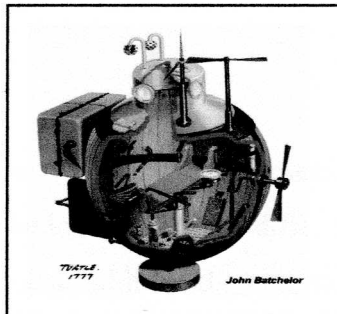


Figure 2.1: David Bushnell's Turtle. Copied from [7].

## 2.3 Submarine Concept and Principles

How submarines dive and surface. Basically, there are two ways to submerge a boat: dynamic diving and static diving. Many model submarines use the dynamic method while static diving is used by all military submarines. Dynamic diving boats are submarines that inherently float that is, they always have positive buoyancy. Lockwood, Charles A. [11]

This type of boat is made to dive by using the speed of the boat in combination with the dive planes to force the boat under water. This is very similar to the way airplanes fly. Static diving submarines dive by changing the buoyancy of the boat itself by letting water into ballast tanks. The buoyancy is thereby changed from positive to negative and the boats starts sinking. These boats do not require speed to dive hence this method is called static diving. [4]

Modern military submarines dive use a combination of dynamic and static diving. The boat submerges by filling the main ballast tanks with water. After that, the buoyancy is accurately adjusted with the trim tanks. Once underwater, the depth of the boat is controlled with the hydroplanes. [5]

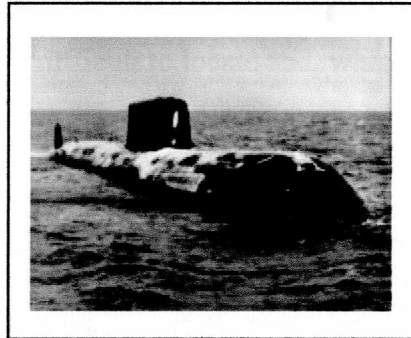


Figure 2.2: K-278 Komsomolets. Copied from [7].

### 2.3.1 Static Diving

The buoyancy of a submarine can be changed by letting water into the main ballast tanks (MBT). The MBT's can be located in three different ways: (a) inside the pressure hull, (b) outside the pressure hull as additional tanks, and (c) in between the outer hull and the pressure hull. Figure 2.3 shows the three possible configurations. This MBT