ECO DESIGN STUDY OF ALUMINIUM ALLOY 5052-H32 AND ALUMINIUM ALLOY 6061 FOR RECREATIONAL AIRBOAT

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

by

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APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (Manufacturing Design) (Hons.). The member of the supervisory is as follow:

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(BAHARUDIN BIN ABU BAKAR)

ABSTRAK

Tajuk untuk projek ini adalah Kajian Rekabentuk Eko bagi Aluminium Alloy 5052-H32 dan Aluminium Alloy 6061 untuk Rekreasi Airboat. Rekabentuk eko boleh di tafsirkan sebagai Mesra Alam Sekitar. Tujuan projek ini ialah untuk mengkaji kesan saiz Rekreasi Airboat kepada alam sekitar, untuk menganalisis kesan alam sekitar berdasarkan bahan untuk membuat rekreasi Airboat dan mencadangkan bahan terbaik berasaskan kepada kesan untuk alam sekitar bagi membuat Rekreasi Airboat. Projek ini hanya memberi tumpuan kepada bot jenis Rekreasi Airboat. Perisian yang telah digunakan bagi membuat rekabentuk Airboat di dalam dalam projek ini adalah SolidWork. Bagi kaedah analisis, di dalam projek ini telah mengunakan Sustainability Analisis yang terdapat di dalam SolidWork. Berdasarkan kajian yang telah dibuat, Aluminium Alloy 6061 adalah lebih baik berbanding Aluminium Alloy 5052-H32. Selain itu, projek ini juga telah memberikan beberapa cadangan untuk meningkatkan kualiti penyelidikan di masa hadapan.

ABSTRACT

The title for this project is Eco Design Study of Aluminium Alloy 5052-H32 and Aluminium Alloy 6061 for Recreational Airboat. The Eco Design can be interpret as Environmental Friendly. The purpose of this project is to study the Recreational Airboat size impact to the environment, to analyse the impact of the environment based on material to make the Recreational Airboat and to recommend the best material based on the environmental impact to make the Recreational Airboat. This project only focuses on Recreational Airboat. The software used in this project is SolidWork to make the design of the airboat. The method of analysis had been used to test the sustainability impact is SolidWork Sustainability Analysis. Based on the research had been made, the Aluminium Alloy 6061 is better than Aluminium Alloy 5052-H32. From this project, it had come out with several suggestions to improve the research

DEDICATION

Lovingly dedicated to my parents, brother and sisters

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Bismillahirrahmanirrahim,

Alhamdulillah, Thanks to Allah SWT, whom with His willing giving me the opportunity to complete this project and report for Projek Sarjana industrial without any problems that interfere during the training period.

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MNMA	-	Malaysia National Marine Authority
UN	-	United Nation
EEZ	-	Exclusive Economic Zone
MTW	-	Maritime Tactical Wide Area
ft	-	Feet
PSM	-	Bachelor Degree Project
Eco Design	-	Environmentally Conscious Design
DfE	-	Design for Environment
UMT	-	Universiti Malaysia Terengganu
LCE	-	Life Cycle Engineering
QFD	-	Quality function Deployment
QFDE	-	Quality function Deployment for Environment
VOCE	-	Voice of Customer and Environment
EM	-	Engineering Metrics
PC	-	Part Characteristics
LCA	-	Life Cycle assessment
LNG	-	Liquefied Natural Gas
GDP	-	Gross Domestic Product

CHAPTER 1
INTRODUCTION

1.1 Project Background

This report presents the Eco Design study of a Recreational Airboat. In this report, it will divide into five chapters. The first chapter explains about the introduction, problem statement, objective and scope of work. The next chapter is Chapter 2. The contents in Chapter 2 will focus on two main items, which is Eco Design and maritime industry. In Eco Design it will explain about the meaning, barrier and benefit. The second item in this chapter shows the detail about the maritime industries. The item which had put under maritime industry is component, activities, services and detail about Recreational Airboat. Chapter 3 is the methodology part, it will explain the method or step to use and finally is making the recommendation for improving the recreational Airboat in Eco Design specification. Chapter 4 and Chapter 5 will explain the detail about the process to obtain the information and finally is developing the new Eco Design Framework in the marine industry.

1.2 Introduction

Eco Design is also known as ecology or environmental based design method to emphasize on the importance of green sustainability. It is also known by other names such as Design for Environment (DfE), Green Design, Sustainable Design, Environmental Conscious Design, Life Cycle Design, Life Cycle Engineering and Clean Design have the same goal and objectives. It can definitely use an approach that considers all the environmental impacts of a product right from the earliest stage

of its design and throughout the product development process by systematic way and encountered with other traditional approaches such as function, safety, ergonomic endurance, quality and costs. Eco Design is very important in human life. Eco Design will help to extend the environment life and it will give the positive impact to human community. As stated in ISO 14O62, that integrating environmental aspects into product development is able to minimize the total environmental impact in a life cycle perspective from raw material extraction, production, packaging, distribution, use, recovery and recycling.

The marine industry had provided higher income for the national economy because the way to import and export the product is usually by sea. It will trigger faster economic growth and also the ease of the coming new technology. The other function for the marine industry is the main supplier of food in human life by fishing activity. Besides that, in maritime industries, it helps the economy grow by providing several types of services such as ship maintenance and repair.

Previously, the implements of Eco Design had shown the higher positive impact to the sector, such as automotive, electrical and electronics and furniture. By implementing the Eco Design in the marine industry, it had expected to help the improvement of the marine industry in term of cost, performance and water pollution.

1.3 Problem Statement

Marine industry is the most important industry in Malaysia because it had given the most valuable income for Malaysia economy. The problem of this industry is the environmental pollution. The pollution had come from the early stage of manufacturing the boat until the end of life. The critical part of pollution is in early stage. The early stage means the stage for making the boat. The process involves in early stage such as design and manufacturing process will give the impact to the environment. The manufacturing process will produce the waste and it will give the bad impact to the environment. The main problem is how to use the process to

minimize the waste and become more environmentally friendly. The design stage is most important. It is needed to study wisely to make sure the design produces not giving the higher impact to the environment. Designs process actually the thing that needs to give more attention because if the design not environmentally friendly, it will effect to entire life cycle of the boat. Currently, the company which manufactured the boat does not give high priority about the impact to the environment when making the boat. The boat manufacturer will make the boat without giving the attention to environment aspect.

1.4 Objective

In this research project, it had three objectives that need to achieve at the end of this research. The objective is:

1. To study the Recreational Airboat size impact to the environment.
2. To analyse the impact of the environment based on material to make the Recreational Airboat.
3. To recommend the best material based on environmental impact to make the Recreational Airboat.

1.5 Scope of Work

This research project will focuses on the Recreational Air boat only. The meaning of Recreation Air boat is the boat use at the river and not a suitable use at the sea. This boat can be used at both water and land. The other thing for Recreational Airboat is the engine turbine not in the water. This research only focuses on the six different sizes. The size will be focuses is 5 meter, 6 meter, 7 meter. 8 meter, 9 meter and 10 meters length of the boat. The design shape for Recreational Airboat is fixed. The analysis will be performed only focus on the Aluminium Alloy 5052-H32 and

Aluminium Alloy 6061. This class of Aluminium Alloy had been selected based on the data obtain from an industrial visit at Marlin Marine Sdn. Bhd. The type analysis will use to do the research is the sustainability analysis that available in the SolidWork software. This analysis also focuses only at the bottom part of Recreational Airboat. The other part in the boat such as boat motor, turbine and seat will eliminate from the research. Besides that, this research focuses wisely on the sustainability aspect of Recreational Airboat. The duration for Recreational Airboat is about 20 years.

CHAPTER 2
LITERATURE REVIEW

This chapter describes in detail about Eco design and the marine industry. In this chapter also describes the relationship of the Eco design in marine industry. Eco design is the keyword for environment friendly aspect and the key how to produce environmentally friendly products, improve the quality of a product with a low cost. Eco design is commonly used in various industries, but in the marine industry, the use of Eco design still in beginner. Eco design can help to develop the process for maintain the environment. This chapter also explain the benefit, barrier and factor to encourage the Eco design concept to implement in industries. By implement this method, it will give the benefit not for environment only, but overall thing include the new cost and improve the product performance. In maritime, it explains the situation and problem was faced by this industries and the government regulation about maritime industries. The Eco design in maritime is the new issues that need to study and it believe the Eco design can improve the maritime industries situation.

2.1 Eco Design Definition

Environmental protection is not a new issue and it had been addressed since long time ago to make sure the earth life will expand. Based on environmental protection issues had produced the term of Eco Design. The Eco Design is also associated with Environmentally Conscious Design. In general, the term of Eco Design is driven to protect environmental issues. Furthermore, the term of Eco Design also usually referred to the environmentally friendly product, green product, sustainable, design for the environment and green design. Environmentally conscious design is a modern green design mode considering both environmental impact and resource consumption

during the first stage of product life cycle (Yongming et al, 2009). Eco Design also gives the meaning of sustainable solutions, products, services, hybrids or system changes that minimize negative and maximize positive sustainability impacts of economic, environmental, social and ethical throughout and beyond the life-cycle of existing products or solutions, while fulfilling acceptable societal demands or needs (Charter & Tischner, 2001). Eco design also gives the meaning of action taken during product development which aims to minimize the environmental effect during the whole life cycle. The whole life cycle means is the stage of acquiring material, fabrication and use of consumables and finally is disposal stage (Eltayeb et al., 2011).

There are five activities which are included in Eco Design. The first activities are designed for reduced or avoid the hazardous material such as lead, mercury, chromium and cadmium. Secondly is design for reuse. This is a design of reuse product or part when it became the end of life. Thirdly is design for recycling. It can disassembly the waste product and separate it by categories the part into several groups such as material and reprocessing material. The fourth is design for remanufacturing. This activity means design for repair, rework and refurbishment which the target is to make the product at least equal to new condition or better and the lastly is designed for resource efficiency. It includes the reduction material use, reduce energy consumption during use and use the renewable resource (Eltayeb et al., 2011).

2.2 Eco Design in Industry

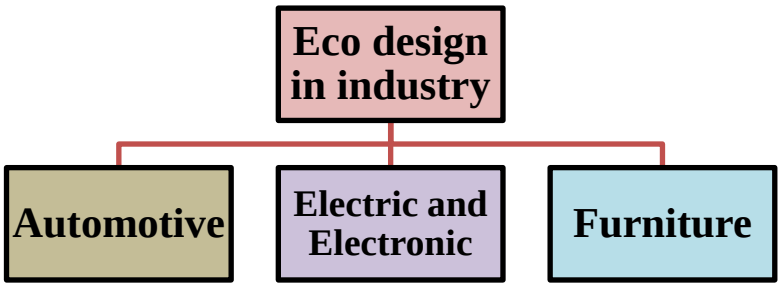

Figure 2.1: Eco Design in Industry Flowchart

Eco Design is not the new issues. It had implemented the Eco Design in many sectors. The example of sector had used Eco Design is automotive, electrical and electronic and furniture. But, in maritime sector, the Eco Design is new thing and it still need to develop the Eco Design in this industry.

2.2.1 Eco Design in Automotive Industry

As known, automotive industries development stage had improved faster since the last decade. The clearest part that can see is the engine development. Besides that, it also focuses on comfortable, safer, drive easily and also focuses on environmentally friendly. For this development, the Eco Design approach had used from development stage until end-of-life vehicle treatment. By using the Eco Design approach, the automobile maker company can easily adopt the environmental rule. The automotive environmental quality had become the decisive issue for the near future. In currencies, the term of green car had used and this term meaning of the low or zero emission (Medina, 2006).

The European end-of-life vehicle directive had made the requirement for car manufacture for calls back the entire car that requires disposal from 2002 and above. The new environmental policies had made and it had mentioned about the car must prevent from containing harm material such as lead, mercury and cadmium. Icon design for automotive industry also considers the used of fuel and how to produce the fuel economy vehicle. This is because the vehicle will produce carbon monoxide, nitrogen oxide, sulphur dioxide and volatile organic compound. Other than that, the method to minimize the fuel consumption for vehicles is reducing the weight. The reduction of 10% of vehicle weight will increase the distance of the car because it can move 5% more with the same amount of fuel (Mayyas et al., 2012).

2.2.2 Eco Design in Electrical and Electronic Industry

Electric and electronic industry more focus on the performance of the products that produce. Aoe (2007) stated that in achieve the target for improve the performance of product, the Eco Design concept had used. The criterion of Eco Design in electric and electronic that must achieve is:

a) Improving functional performance and reducing environmental Impacts.
b) Reducing environmental impacts and reducing functional performance.
c) Improving functional performance and increasing the environmental impacts.

In order to achieve sustainable development, Eco Design requires a change of direction to technological progress which is able to improve functions while at the same time reducing environmental impacts. On the other hand, to implement Eco Design, namely incorporate the environment into the product development process, an indicator is required for evaluating and promoting not only environmental aspects, but also technological progress which is able to strengthen marketability (Aoe, 2007).

2.2.3 Eco Design in Furniture Industry

The furniture industry is basically an assembling industry, which employs different raw materials such as wood, metals, plastics, and leather to manufacture different products. In growth of time, the furniture produces more concern about the aesthetic value in their product and the current era, the concern is more focus on the environmental aspect.

The new thing in furniture industry is the material to produce the product more on the environmental friendly. The research had been conducted and it has shown to selected the new wooden which had modify the structure and had been selected as the best material for use in many different applications as it has a minimal impact on the environment compared to other materials. Wood can be minimizing the impact to