UNIVERSITI TEKNIKAL MALAYSIA MELAKA

STRUCTURAL DESIGN AND ANALYSIS OF MAIN TANK FOR RIVER TRASH COLLECTOR SYSTEM (RTCS)

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

by

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I hereby, declared this report entitled "A Study to Design and Fabricate Body Mechanism for River Trash Collector System (RTCS)" is the results of my own research except as cited in references.

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Date : 15 December 2017.

APPROVAL

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

Encik Mohd Idain Fahmy Bin Rosley

(Project Supervisor)

ABSTRAK

Kebelakangan dekad ini telah menyaksikan pencemaran air sebagai isu penting untuk seluruh dunia. Ia mengancam kesejahteraan dan kemakmuran masyarakat, tumbuh tumbuhan, dan makhluk. Ketika dunia ternyata menjadi lebih moden dan lebih kecil kerana persimpangan dan pertukaran, ia menambahkan risiko kepada isu pencemaran laut dan sungai. Dari masalah pencemaran air ini, konsep sistem pengumpul sampah sungai diperkenalkan untuk mengurangkan pencemaran di kawasan air.Sungai Melaka merupakan salah satu daya tarikan untuk pelancong di Melaka. Disini terdapat aktiviti meniki bot menyusuri sungai Melaka untuk melihat keindahannya. Kos yang tinggi telah dikeluarkan oleh Kerajaan Negeri Melaka bagi mengindahkan persisiran sungai dengan membuat pembaikan pada struktur perumahan yang ada disepanjang sungai. Hasilnya indeks tahap kualiti air semakin meningkat dan perskitaran sungai Melaka semakin meriah dan indah. Walau bagaimanapun , sungai Melaka terus dibelenggu dengan pencemaran sampah. Sampah ini terhasil dari aktiviti seharian manusia yang tidak menghiraukan kebersihan dan juga aktiviti pembersihan sungai Melaka. Pembersihan sungai Melaka (*flushing*) dilakukan dengan membuka pintu empangan dihilir bagi membenarkan air laut masuk kedalam sungai. Air laut yang masuk akan membersihan kekotoran lumpur dan bercampur dengan air sungai bagi menyahkan bau.Tetapi kemasukan air laut juga menyebabkan kesan sampingan. Air laut yang masuk akan menolak bersama sampah yang terkumpul diempangan untuk turut serta masuk kesungai Melaka. Dari masalah pencemaran air ini, konsep sistem pengumpul sampah sungai diperkenalkan dengan menggunakan bot pemungut sampah. Walaubagaimanapun satu inovasi yang lebih menjimatkan kos dan efisyen telah dicipta iaitu pengumpul sampah sungai. Mekanisma terapung yang digunakan penting untuk memastikan sistem pengumpul sampah sungai mempunyai kecekapan untuk terapung dengan menggunakan sistem apungan dan konsep tangki balast. Projek ini mengkaji spesifikasi konsep apungan pengumpul sampah di dalam air dan kajian sebelumnya menerangkan tentang ciri-ciri yang digunakan dalam peranti ini. Dalam usaha untuk menyelesaikan maslah-masalah didalam inovasi yang terdahulu, kajian telah keatas pemungut sampah sungai yang direka berdasarkan beberapa konsep idea dan cadangan bahan yang akan digunakan. Kajian yang dijalankan akan mengenalpasti setiap reka bentuk mempunyai ciri-ciri tertentu, kebaikan dan keburukan. Tambahan pula,

SolidWorks adalah perisian yang digunakan untuk mereka bentuk sistem pengumpul sampah sungai perisian Solid Thinking atau perisian ANSYS digunakan untuk menentukan kemampuan rekabentuk, ketahanan dan kesan terhadap faktor persekitaran. Setelah rekabentuk yang dikehendaki diperolehi berdasarkan data dan maklumat yang mencukupi, Mesin Rapid Prototyping digunakan untuk menghasilkan komponen atau model mengikut skala yang ditetapkan.

ABSTRACT

The recent decade has witnessed water pollution as an important issue for the entire world. It threatens the welfare and prosperity of the people, plants, and creatures. As the world turns out to be more modern and smaller as the intersection and exchange, it adds risk to the marine and river pollution. The problem of water pollution, river trash collector system concept was introduced to reduce water pollution in the area. Sungai Melaka is one of the tourist attractions in Malacca. There are boating to see the beauty of the river. Malacca State Government has issued a high expenditure for the beautification of riverfront with making repairs to existing residential structures along the river. As a result, the index of water quality is rising and river surroundings Melaka more festive and beautiful. However, the Melaka river continues to be plagued with waste pollution. The waste resulting from human activities are not concerned about daily hygiene and cleaning activities river. Melaka River cleaning (flushing) is carried out by opening the door of the dam downstream to allow sea water into the river. The sea water mixed with river water that goes to wash the mud and dirt to aid smelly. They also cause side effects. Seawater entry will be refused with the accumulated garbage at dammed into Melaka River. From the problem of water pollution, a cost-effective technology has been introduced known as River Trash Collector System (RTCS) to collect the rubbish. It used floating mechanism and concept of ballast tanks to ensure River Trash Collector System (RTCS) has the competence to float on the river. The project is studying the specifications of float mechanism for River Trash Collector System (RTCS) in the water and the previous study describes the features that are used in these devices. In order to solve the problems encountered in the previous innovation, research has conducted to River Trash Collector System (RTCS) based on ideas of designed and suggestions of materials to be used. The study will identify each design has particular characteristics, advantages, and disadvantages. Furthermore, Solid Works software is used to design the system for River Trash Collector System (RTCS). Meanwhile, Solid Thinking software or ANSYS software is used to determine the ability of design, durability, and impact on the environment. After the desired design is obtained based on data and information adequate, Rapid Prototyping machines used to produce components according to scale the model established.

DEDICATION

To my beloved parents, Rojani Bin Samsudin. Thank you for all support, sacrifices, patient, and willingness to share with me. To my honored supervisor and co-supervisor, Encik Mohd Idain Fahmy Rosley, Encik Mohd Fariduddin Mukhtar, and all UTeM lecturers. Thank you for always giving me a guidance and persistent help to complete this project thesis.

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He also provides me an opportunity to cooperate with him on designing a project. By spending his valuable time, he shared his knowledge with his full attention in carrying out this project thesis. I also want to express my gratitude towards my beloved parents and families for their kind motivation to go through all the hard works and they gave me their support and positive vibes while carrying out this project. In addition, I am very grateful for those giving me a chance to ask information from the basic conceptual idea of the project. My big appreciations also go to the people who have directly or indirectly helped me in developing this project thesis. Once again, thank you so much for all support.

LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

RTCS – River Trash Collector System

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CHAPTER 1

INTRODUCTION

1.0 Research Background

Malacca River is now better known as a tourist and recreation. There are boat rides along the river Melaka to see events around the state-run by PPPSM. Moreover, PPPSM also were responsible to ensure the cleanliness and beauty of the river Melaka maintained that continues to attract tourists. One of them is water pollution which occurred in the Malacca River. Pollution is the introduction of contaminants into the natural environment that causes adverse change. Pollutants, the components of pollution, can be either foreign substances or energies or naturally occurring pollutions. The water pollution is a physical, chemical, or natural change of a water asset that adversely influences the living beings that make water unacceptable for the desired use. The issues are greater in the creating nations, where customary wellsprings of contamination. For example, modern discharges, poor sanitation, deficient waste administration, debased water supplies and exposures to air contamination from biomass fuels influence extensive quantities of individuals.

A research by Li in (2009), a major barrier to water pollution forecasting is the absence of a proficient system for water pollution checking. Customary water pollution examining is tedious, costly, and must be taken in little sizes. Water pollution has turned into a wellspring of human disease. On the other hand, water which sustains human has ended up undetectable killer of humankind. Besides that, there has a lot of trash in the water. Trash float at water level, permitting ocean water bound with trash, oil, and cleansers persistently to spill into it. Thus, water pollution is about amounts of polluting substance discharged and how enormous a volume of water is released. A little amount of a harmful synthetic may have little effect on the off chance that it is spilled into the sea from a boat. Be that as it may, the same

measure of the same synthetic can have a much greater effect pumped into a lake or river, where there is less perfect water to disperse it.

A USD$100 million (RM350 million) infrastructure project to revive and rejuvenate the river which is central to Malacca as a historic city was carried out. This has included construction of a tidal barrage, restoration of buildings and bridges, dredging, concrete river banks with river walkways. Land reclamation projects have extended the river mouth further into the Straits.(De Witt 2010)In recent year, the Malacca River has been tidied up and restored from one of the dirtiest rivers in Malaysia turned into a good example of another state. The Malacca River has enhanced to grad B and they are attempting to enhance it to grade A. The water will be discharge once it water level tallness achieved 7 meters. Generally, the water will be discharge amid 2-3am consistently as this is high tide period. At that point, they let seawater into the river and close the entryway to give the river a chance to water blend with sea water. The mixing methodology of seawater expels smell of river brought on by natural matter found in the waterway. By then, the water will be released to the sea through the gate of the river between Malacca Waterway and ocean. At that point, the water will be discharged to the sea through the door worked between Malacca River and sea. This flushing methodology evacuates the terrible stench of Malacca River utilizing sea water.

River Trash Collector System (RTCS) is introduced in order to reduce pollution in the water area. The general idea comes from Sea bin concept which acts as a trash collector in the sea area. But, there several improvements necessarily in River Trash Collector System (RTCS) based on green technology concept. Besides, floating mechanism is also important to make sure the River Trash Collector System (RTCS) has an efficiency to float by using buoy system and ballast tank concept. This project reviewed on the River Trash Collector System (RTCS) conceptual specifications and previous study about characteristics that are used in this device. In order to solve water pollution cases, River Trash Collector System (RTCS) is designed based on several concept ideas and suggestion of material to be used.

(Kean Hua & Ping 2016) also indicated that utilization of strategy in controlling and dealing with the water assets in Malacca River can be effectively actualized. Be that as it may, the arrangement will take a long haul to actualize.

Furthermore, the Malacca River that loaded with refuse and plastics bottles in the past is currently being spotless utilizing trash collector boat which is changed by them. This cleaning boat has a gap with a net in front to trap the garbage into it. This procedure just needs one watercraft driver and another gatherer. The gatherer is mindful to gather the huge waste into the receptacle to anticipate blockage. The garbage will be gathered once per day, and every procedure just takes around 3 hours for the entire river. This garbage authority vessel made the procedure of gather trash simple and quick if contrast with last time. Figure 1.1 below shows the trash collector boat in operation system.

1.1 Problem Statement

The standard of design body (RTCS) can is used as the referral design for this project. We are designing a new design to replace the prototype design. The body of (RTCS) are already made by the various type of materials that make them strong, can withstand a heavy load and make more places. But there are some criteria and designing a part that they have considered. Which is there materials used, weight, building, space, and purpose? Hence, our design needs to convert and redesign a new product that can be a function. In new design of different in size, used, weight and this will give a conversion to the body (RTCS). The new design of (RTCS):

River Trash Collector System (RTCS) has a body in their concept to make sure that trash collector can work perfectly. from past research RTCS only at the level of the prototype only. A connector having a floating structure incorporates a floating holder for coupling segment associated with a compact electrical contraption to a base through a drifting instrument. The floating holder is shaped of plastic as a different part of a connector fundamental body that gave the fitting coupling segment. However, there are improvements to be made to existing forms to be customized according to the needs and problems faced.

1. Inappropriate design body RTCS by State for easy maintenance.
2. Constraints of space to put RTCS due to the small width of the Malacca River cause.
3. RTCS difficult to put in suitable areas to avoid being hit when the boat odds. Movement and disputes between the boats also produced strong waves that can cause RTCS budge

1.2 Research Objectives.

The objectives of this study were as follows:

1. To study the previous RTCS regarding its pros and cons.
2. To design an improved main tank system of RTCS.
3. To analyze main tank structure of (RTCS) by using solid thinking software.

1.3 Scope of the Research

The aim of this project is to focus main tank design RTCS provide device very important for River Trash Collector System (RTCS) in order to function effectively and efficiently. Besides that, there are improvements to be made to the existing body (RTCS) to be customized according to the problem that has been encountered which is to design the main tank for (RTCS) and analyze the structure by implementing Topology Optimization from solid thinking software.

1. Design: design the body of the RTCS using solid work. .
2. Analyse: analyze structure from Solidthinking software.

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1.4 Significance of Research

Research embarked improved on body River Trash Collector System (RTCS). A research of this body design identified from the River Trash Collector System (RTCS) which was built. Manufacture body (RTCS). In order to overcome the problem of body mechanics, the new design this takes into the design to ensure the efficient functioning of River Trash Collector System (RTCS) in Malacca River. The River Trash Collector System (RTCS) is based on green technology concept that can help in reducing pollution. This concept of design can have considered new and there have improved characteristics to make sure the River Trash Collector System (RTCS) to good working order and reduce pollution in the water area.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

This chapter reviews on design using multiple software and analysis the main tank (RTCS), corrosion method and improve main tank design RTCS system at Malacca River. Improvement characteristics based on green technology, power system, the new for main tank design RTCS. Besides, this chapter briefs more description about the improvement the design and manufacturing main tank RCTS. From literature review, it can study to now improve the project (RTCS).

2.1 Principle of Design and Stress Analysis

In designing the main tank (RTCS), the specifications of the test body such as functions, design requirements and evaluation criteria must be defined clearly. According to Mott (2004), functions tell what the device must do, use general, non-quantitative statements that employ action phrases such as to support a load, to lift a crate, to transmit power or to hold two structural members together. Moreover, he said, design requirements are detailed, usually quantitative statements of expected performance levels, environmental conditions in which the device must operate limitations on space or weight or available materials and components that may be used. Whereas, evaluation criteria are the statements of desirable qualitative characteristics of a design that assist the designer in deciding which

alternative design is optimum- that is, the design that maximizes benefits while minimizing disadvantages.

To start a design main tank (RTCS), a lot of factors must be taken into consideration. Mott (2004) has summarized some factors to be taken into consideration, which as listed below:

1. Forces exerted by the components of the machine through mounting points such as bearings, pivots, brackets, and feet of other machine elements.
2. The manner of support of the frame itself.
3. The precision of the system: allowable deflection of components.
4. The environment in which the unit will operate.
5. The quantity of production and facilities available.
6. Availability of analytical tools such as computerized stress analysis, past-experience with similar products, and experimental stress analysis.
7. Relationship to other machines, walls and so on.

2.2 Material

Selection of material has a high effect on the structural strength. The most significant factor to evaluate the material strength is by referring to the yield strength, σy and the modulus of elasticity, E of the material. Mott (2004) stated that yield strength can be defined as the portion of the stress-strain diagram where there is a large increase in strain with little or no increase in stress. He also stated that modulus of elasticity can be defined as stress proportionality to strain when the part of the stress-strain diagram is straight. Modulus of elasticity indicates the stiffness of the material or its resistance to deformation.

2.3 Stress

Based on Mott (2004), there are three basic fundamental kinds of stress; tensile, compressive and shear. Tensile and compressive stress, called normal stresses, are shown acting perpendicular to opposite faces of the stress element. Tensile stresses tend to pull on the element whereas compressive stresses tend to crush it. Shear stresses are created by direct shear, vertical shear in beams or torsion. In each case, the action on an element subjected to shear is a tendency to cut the element by exerting a stress downward on one face while simultaneously exerting a stress upward on the opposite, parallel face. Stress can be defined as the internal resistance offered by a unit area of a material to an externally applied load.

$$\sigma = \text{force/area} = F/A$$

Based on Mott (2004), the behavior of members having noncircular sections when subjected to torsion is radically different from that for members having circular cross-sections. However, the factors of must use in machine design are the maximum stress and the total angle of twist for such members. The formulas for these factors can be expressed in similar forms to the formulas used for members of circular section (solid and hollow round shafts).

$$Tmax = T/Q$$

where; Q = section modulus

Based on Mott (2004), a beam is a member that carries loads transverse to its axis. Such loads produce bending moments in the beam,

which result in the development of bending stresses. Bending stresses are normal stresses, that is, either tensile or compressive. The maximum bending stress in a beam cross-section will occur in the part farthest from the neutral axis of the section. At that point, the flexure formula gives the stress:

$$\sigma = Mc/I$$

where; M = magnitude of the bending moment at the section

I = moment of inertia of the cross-section with respect to its neutral axis

c = distance from the neutral axis to the outermost fiber of the beam cross section

Positive bending occurs when the deflected shape of the beam is concave upward, resulting in compression on the upper part of the cross-section and tension on the lower part. Conversely, negative bending causes the beam to be concave downward.

When the dimension is already fixed, the yield strength of the material can be changed to make sure the design will not fail due to bending at specifying force. So, by using the dimension, calculate the moment of the beam. Then calculate the stress due to the bending and compare it with a yield strength of the material. If the stress due to bending is smaller than the yield strength of the material, thus it means that the beam dimension with the material used will not fail if the specified force is applied.

2.4 Design Factors

Based on Mott (2004), design factor, N is a measure of the relative safety of a load-carrying component. He stated that in most cases, the strength of the material from which the component is to be made is divided by the design factor to determine a design stress, σd sometimes called the allowable stress. Then the actual stress to which the component is subjected should be less than the design stress. For the case of the buckling of columns, the design factor is applied to the load on the column rather than the strength of the material.

2.5 Tidal Source

Today people know that the gravitational pulls between the earth, moon, and sun dictate the tides. The moon, however, influences tides the most. The moon's gravitational pull on the earth is strong enough to tug the oceans into the bulge. If no other forces were at play, shores would experience one high tide a day as the earth rotated on its axis and coasts ran into the oceans' bulge facing the moon. Based on Pugh (2001) the two main tidal features of any sea-level record are the range (measured as the height between successive high and low levels) and the period (the time between one high (or low) level and the next high (or low) level).Spring tides are semidiurnal tides of increased range, which occur approximately twice a month near the time when the moon is either new or full. Neap tides are the semidiurnal tides of the small range which occur between spring tides near the time of the first and last lunar quarter. The tidal responses of the ocean to the forcing of the moon and the sun are very complicated and tides vary greatly from one site to another.

However, inertia, the tendency of a moving object to keep moving, It affects the earth's oceans too. As the moon circles the earth, the earth moves