

INTEGRATED DESIGN – GRASS CUTTER AND COLLECTOR MACHINE

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Bachelor of Mechanical Engineering (Automotive) with Honour”

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For my beloved grandparent, Dearest
family members and next of kin,
Lecturers and friends

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ABSTRACT

At present, the cutter machines that drive by the tractor at golf field only have the single function which is cutting the grass. The machine cannot collect the residual grass that has been cut. The workers that related need to collect the grass after been cut using the manual methods. In this report describes about the study of development of a grass cutter and collector machine in golf field. The study that conducted includes the related aspects in development of a machine in the engineering field. The studies of this machine begin with problem statement, gather information, idea development, conceptual design, concept evaluation and concept selection. After the appropriate concept was selected, the concept will be developed using CATIA software which is the design software in 3 dimension mode. After the selected concept been drawn using CATIA software, the simulation process will be conducted for these design. Simulation process will be made to examine the function and operation of each component on this machine. After that, the design will be tested for analysis process also using some application in CATIA software. The analysis process is important to determine the strength of the design against the pressure that exerted to the design. In the engineering side, analysis process is to determine the safety factor of the design developed.

ABSTRAK

Mesin pemotong rumput yang dipacu oleh traktor di padang golf pada masa sekarang mempunyai fungsi tunggal iaitu memotong rumput. Sisa rumput yang telah dipotong tidak dapat dipungut oleh mesin pemotong rumput tersebut. Pekerja yang terbabit akan mengumpul sisa rumput yang telah dipotong dengan kaedah manual. Di dalam laporan ini menerangkan tentang kajian pembinaan sebuah mesin pemotong dan pemungut rumput di kawasan padang golf. Kajian yang dijalankan adalah merangkumi pelbagai aspek berkaitan dengan pembangunan sesebuah mesin di dalam bidang kejuruteraan. Kajian terhadap mesin ini bermula daripada penyataan masalah, pencarian maklumat, pembangunan idea, penghasilan rekabentuk konsep, penilaian rekabentuk, dan pemilihan rekabentuk. Setelah rekabentuk konsep yang sesuai dipilih, rekabentuk yang teliti akan dibangunkan. Proses merekabentuk ini menggunakan aplikasi CATIA iaitu sejenis aplikasi rekabentuk berbentuk 3 dimensi. Setelah rekabentuk mesin yang teliti telah dihasilkan, aplikasi CATIA akan digunakan untuk menghasilkan simulasi terhadap mesin tersebut. Simulasi ini akan menunjukkan pergerakan dan fungsi setiap komponen yang telah dihasilkan. Setelah simulasi berjaya dihasilkan, rekabentuk mesin tersebut akan dianalisa menggunakan aplikasi CATIA. Proses analisa ini penting untuk melihat kekuatan rekabentuk tersebut terhadap tekanan yang dikenakan terhadap rekabentuk yang dihasilkan. Dengan kata lain, proses analisa perlu dibuat terlebih dahulu supaya faktor keselamatan sesuatu rekabentuk dapat dikenalpasti sebelum rekaan yang sebenar dibangunkan.

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LIST OF ABBREVIATION

	=	Stress cycle factor for Pitting Resistance
	=	Stress cycle factor for Bending Strength
	=	Reliability Factor
	=	Temperature Factor
	=	Crowning Factor for Pitting
Np	=	Number of Pinion
Ng	=	Number of Gear
	=	Diametral pitch
	=	Size for Pitting Resistance
	=	Load Distribution Factor
	=	Bending Stress
	=	Permissible Bending Stress Equation

CHAPTER 1

INTRODUCTION

1.1 RESEARCH BACKGROUND

This project is the study about design and development of a grass cutter and collector machine that be pulled by the tractors. The machine is operated for cutting and collecting the grass on golf field and other large field areas. The concept idea for this project is to combine the function of two elements into one for example, after the cutting process the collecting process will be done simultaneously. Several criteria in engineering aspects must be considered to develop an idea for this project. For the project, it called as integrated design because of the function of the machines that be researched and it was a new of machine concept. It was operated with helped by the tractors, same as the current concept for the operation progress. The machines also designed on suitability for the grass types in golf field or recreational field in Malaysia as well. The concept generation will be headed after making evaluation from the criteria considered. This project is more related to the engineering design field, so all the criteria in the design specification must be followed to get the best result at the end of the project. These projects are more to design process, so it uses CATIA software to develop the detail design of the concept selected. The simulation can be made using CATIA software to identify the function of each component in this project. At the end of the research, the result of analysis of the structure will be discussed for the design selected.

1.2 PROBLEM STATEMENT

Grass that grows in the area such as golf field and recreational field was difficult to collect after cutting process. The existing machines was created before, is just only cut the grass and the workers need to collect the grass manually after the process. This machine is pulled by the tractor to run the cutter blade using the propeller located at rear of the tractor.

1.3 OBJECTIVE OF PROJECT

The main objective of final year project is to enable students to be independent in solving problems that related to the engineering field involving course taken. All the skills that have learned will be applied in this project to achieve the project target. This project also trains students in real-life situations in the design of a machine that encompasses all aspects of engineering. Therefore, the objective of this project is:

- I. Study about design and development of a machine in engineering design field.
- II. To design (using CATIA) a machine that used to cutting and collecting the grass and this machine operates with helped by the tractor.
- III. To conduct analysis for critical part of the design.

1.4 SCOPE OF PROJECT

In order to complete this project, it requires a precise scope of work and the right plan to be followed for this project must go through various processes before it is produced. Besides that this project is a new concept that comes from literature review related to the design in the market now. To make this study more specific and details, there were some scopes must be considered as well:

- I. Covering all aspect in design engineering start from define problem, concept generation, evaluate concept, simulation process until analysis.
- II. Research on the structure of the design that appropriate to the speed of the tractor.

1.5 PROJECT OUTLINE

Chapter 1 consist the introduction part of the project such as the background, problem statement, objectives of the project and also the scopes of the project.

In chapter 2, it consist the literature review grass cutter machine, types of grass cutter machines, the string trimmer, the grass collector machine and the types of grass in Malaysia. It consists of the definitions, overviews, histories, manufacturing, elements, functions and applications of all the terms stated above.

Chapter 3 is basically explaining the methodology on how the study and experiment has been conducted. During this project, it will review about the methods used, concept generation, the concept selections, the designs and the evaluation method and also the procedure of the software used for design via CATIA of this study. In this study, the concept design that chosen after the evaluation method has been review and discussed from the reason the concept are chose to the project specifications

In chapter 4, the project specification and parameter will identified for design the project using related software such as CATIA. After that, the simulation will be made to shows the function for each component in the design that produced. The analysis results from theoretical are presented and discussed.

In the 5, the conclusion has been made and for the future works, there is also recommendation added. The recommendation is added to give an opinion and also an improvement on how the future works should have done.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

There are several grass cutter and collector machine that promoted in market to make easier for users to work with it. As we know, there are some types of the grass cutter and collector which is in difference concept and functions.

The grass cutter machine can be separated in a main concept such as manual or automatic. Manual grass cutter machine is more about the machines that used by the user manually using energy that produce by the body and assisted by the mechanicals concept. Usually, the users need to spend more energy to use this type of machine by using human body energy. It also can be called as semi-manual machines because it is not fully on manual function only. For example, the petrol grass trimmer machine is the manually machine that powered handheld device that uses a flexible monofilament line instead of a blade for cutting grass and other plants near objects. Otherwise, the automatic machines more to the device that run independently and using less manpower to operate. However, it called as automatic because of the operating system that operate in the systematic ways and the user can easily use this device without spend more energy. Automatic grass cutting machine or grass collector machine often available in machine that run by the single engine and the machine control all the system such as cutting tools and collector function.

The automatic grass collector and grass cutter also can be classified in two types which is using electric motor or combustion engine such as petrol engine. The machine that uses electrical motor mostly in small device and it is fully automatic because using a sensor to detect the grass that needed to cut. This device is in robotic function that detects the grass automatically based on the power from battery. At present, many machine or device frequently use electronic board for their processing system or can be called as intelligent technology. Otherwise, there are some machines uses the petrol engine to run the machine for cutting and collecting function. This machine also can be controlled by the users as the device same with the existing machine but it running in single rides.

Basically, the surface of the ground also is the factor to build a good machine for grass cutting and collecting grass. In the certain ground area, there are non-flat surface which is hilly and need to concern to design the machines. This factor should be concern because to make sure the grass cutter machine can perform to cut the grass in higher efficiency.

The existing design of grass cutter will be studies because it is important to determine what the problems of the previous design. It is also necessary to discover the advantages and functions of the existing design for improving the previous design. So, the several existing design was taken to this studies as references to reach the scope of the research. The advantages of the previous design must be identified to compare with a new design concept and as a guide for the development of the research. There are several existing designs that been taken for this research shown below:

2.2 STRING TRIMMER



Figure 2.1: String Trimmer (Source: George Charles Ballas, (1971))

The String Trimmer was designed by the American entrepreneur, George Charles Ballas in 1971. This design also called as “weed eater” in the beginning of the development because when it chewed up the grass and weeds around trees. Ballas got the ideas to develop this device while watching the rotating brushes when he driving through the automatic car wash. For the Ballas ideas, this concept use the concept of rotating the fishing line in high speed rotation using the power from the gasoline engine that driven by the propeller.

When the propellers rotate the string, it produces the high speed rotation that exerts the centripetal force to prevent the string from flying off in the straight line under the inertia law. The powerful rotation occurs, it provide higher speed of the cutting section. String Trimmer mostly used in the small area of grass section. This is because the design of this machine is created for the home garden. It is suitable for a small area because of the designs for cutting section is small and the users need to take on the string trimmer to cut the grass. This operation can be determined as traditional concept because the users carry on this powered handheld machine during cutting the grass.

The disadvantages of this concept design is when we want to cut the big grass area such as golf field or recreational field, it need such a long working time to reach the goal of cutting process. It also requires more workers to complete the work compare to the other machines. Therefore, it is produce the risk for the user during the operation because of safety during the cutting process requires the users to wear the safety tools such as eye protection and safety boots. The operator should have the proper personal protective equipment (PPE) including safety glasses and hearing protection. A full face shield, long pants and long sleeves are also recommended. A string trimmer user must also be very aware of their surroundings. Flying rocks and debris can injure onlookers and damage property.

2.3 CYLINDER LAWN MOWER



Figure 2.2: Lawn Mower (Source: Edwin Budding, (1827))

The creator of lawn mowers was Edwin Budding in 1827 from Gloucestershire, South West England. Lawn Mower was designed primarily to cut the lawn on sports ground also expensive ground as a superior alternative to the scythe. This design was patented in 1830 after the successful achievement of improvement.