‘Saya/Kami* akui bahawa telah membaca
karya ini dan pada pandangan saya/kami* karya ini
adalah memadai dari segi skop dan kualiti untuk tujuan penganugerahan
Ijazah Sarjana Muda Kejuruteraan Mekanikal (Rekabentuk)’

Tandatangan : ……
Nama Penyelia I : ……
Tarikh : ……

Tandatangan : ……
Nama Penyelia II : ……
Tarikh : ……

DESIGN AND TESTING OF MECHANICAL JUICE EXTRACTION ESPECIALLY FOR SUGAR CANE

TEH KHANG LING

This report is submitted as partial requirement for the completion of the Bachelor of Mechanical Engineering (Design and Innovation) Degree Program

Faculty of Mechanical Engineering
Universiti Teknikal Malaysia Melaka

MAY 2010

PENGAKUAN

"Saya akui laporan ini adalah hasil kerja saya sendiri kecuali ringkasan dan petikan yang tiap-tiap satunya saya telah jelaskan sumbernya"

Tandatangan : …….

Nama Penulis : Teh Khang Ling

Tarikh : …….

DECLARATION

"I hereby, declare this thesis is result of my own research except as cited in the references"

Signature : …….

Author Name : Teh Khang Ling

Date : …….

DEDICATION

To

My Beloved Family

My Parent

Teh Khang Zing

AKNOWLEDGEMENT

First and foremost, I wish to express my profound gratitude to Mr. Nazim as the final year project supervisor who has gracefully offered his time, attention, experiences and guidance throughout the completion of the investigation thus far.

Besides, would not forget to extend my heartfelt thanks to the university library for providing lots of sources which assistant to complete the report. Besides, would also not forget to thank to the technician who provided help in the sugarcane compression testing.

I would like to thank each and every individual who have either directly or indirectly helped me throughout the efforts of this report be it in the form of encouragement, advice or kind reminders. Finally kudos goes out to family and parents who endured this long process which gave me love and support all the way.

ABSTRAK

Tumpuan utama dalam projek ini adalah mereka bentuk satu mekanisme cekap / mesin yang berkeupayaan untuk memerah jus tebu. Mesin ini mesti dikendalikan sepenuhnya dengan hanya menggunakan kuasa mekanikal. Semua maklumat penting dikumpulkan dengan menjalankan kajian ilmiah. Kemudian, carta mofologi telah dihasilkan. Daripada carta ini, sepuluh rekaan konsepsi akan dihasilkan di bawah keperluan spesifikasi rekaan kejuruteraan. Selepas itu, penilaian terhadap rekaan konsepsi akan dibuat melalui matrik permarkahan konsep untuk memilih rekaan yang terbaik. Semua konfigurasi terhadap bahagian-bahagian standard akan dikenalpastikan. Disebabkan mesin itu hanya beroperasi secara mekanikal sepenuhnya, adalah amat penting untuk memastikan tenaga yang diperlukan untuk mengoperasikan mesin tersebut tertampung dengan tenaga manusia normal. Disebabkan itu, pengiraan terhadap daya untuk mengoperasikan gear akan dijalankan. Pada masa yang sama, pengiraan terhadap komponen mekanikal yang lain seperti aci dan galas juga dilakukan serentak. Di samping itu, analisis dengan menggunakan CAE akan dibuat pada aci untuk mendapatkan faktor selamat yang diingini. Simulasi juga akan dijalankan berserentak dengan analisis. Selepas itu, pemilihan terhadap bahagian-bahagian standard akan dijalankan dan akhirnya, EBOM terhadap produk akan dibina dan pengiraan kos terhadap keseluruhan projek akan dilakukan.

ABSTRACT

The main focus in this project is to design an efficient mechanism/machine that is able to extract sugar cane juice. The machine must be fully operated by only mechanical power and no external force is added in. All the necessary information is gathered by constructing the literature study. After that, morphology chart is created. By this, ten conceptual designs are generated with the requirement of the engineering design specifications. Among them, one of the conceptual designs is chosen for the best design after evaluation by using the concept scoring matrix, and, all the orientation and configuration of the parts of the machine will be justified. Since the machine is designed to be fully operated mechanically, it is very important to make sure that the force required for operating the machine is as less as possible, and hence, the calculations regarding the force to operating the gears are necessary to be carried out. Similarly, calculations will be done on the other mechanical parts such as shafts and bearings as well. Besides, CAE analysis will be emphasized on the shafts in order to obtain the desire safety factor after the construction of the drawing of the best design chosen. This will be followed by conducting the simulations and at the same time analysis is proceeding. After that, selection of the standard parts will be carried on and, finally, EBOM of the product will be constructed and product costing will be calculated.

LIST OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOLS

m	=	module of gear
dp	=	diameter pitch
$k'V$	=	velocity factor
f	=	face width
ω^{t}	=	force transmitted
y	=	lewis factor
σall	=	allowable stress

LIST OF ABBREVIATIONS

CAD	=	Computer-Aided Design
CAE	=	Computation-Aided Engineering
FEA	=	Finite Element Analysis
PDS	=	Product Design Specification
EDS	=	Engineering Design Specification
MEM	=	Mineral Extraneous Matter
BOM	=	Bill of Material
EBOM	=	Engineering Bill of Material

LIST OF APPENDIX

CHAPTER I

INTRODUCTION

This chapter will roughly introduce the background of the sugar cane and also the usage of the existing sugar cane crusher. Besides, some ideas regarding the demands of the white sugar that produced by extracting the sugar cane will also been touched under this chapter. Last but not least, the usage and the importance of the mechanical power's sugar cane crusher will also being introduce in this chapter.

1.1 Background Study

Sugar cane is well known with its purpose especially to produce the white sugar in our daily life. They are native to warm temperate to tropical regions of Asia and they have stout, jointed, fibrous stalks that are rich in sugar and measure 2 to 6 meters tall. All sugar cane are interbreeds species, and the major commercial cultivars are complex hybrids. By determining the taxonomic interpretation, sugar cane, is any of 6 to 37 species of tall perennial grasses of the genus, Saccharum, which is the family of Poaceae, Tribe Andoprogoneae.

From the aspect of producing white sugar, sugar cane exactly play as an important role. The statistic shown that the demands of the white sugar will be achieved its new high record in 2009 due to the high demands of the world top's sugar consumer country. Raw sugar futures are expected to rise to 19 cents per lb by

the end of 2009, and to range around 18 cents in 2010, compared with 11.81 cents per lb touched on the last trading day of 2008, according to median forecasts. [22]

Furthermore, besides producing white sugar, sugar cane is also famous with its delicious juices. This juice is usually extracted by using a semi-automated sugar cane crusher that we usually can see in the market. The machine is built up by some gears and bearing which connected to an operating motor. There will be a space that designed for us to insert the sugar cane for extracting the juice. For some advanced machines, the clinker of the sugar cane will be directed and stored in a separated part after extracting the juice.

On the other hands, there is another type of sugar cane extractor that might operate by only using mechanical power. The whole structures and also the parts involved to built up this type of machine are almost same with the semi-automated type, just this type of extractor are no longer connected to an operating motor, but to a handle that operating by human energy. However, due to the lower efficiency of this type of extractor, it is not suitable for commercial used in the market.

1.2 Problem Statement

Nowadays, most of the sugar cane juice extractors are designed to be functioned by using a motor as its supporting device. It is obviously a quicker and much efficient method in order to produce a high quantity of sugar cane juice. Besides, by using a motor, lesser human energy is required for the operating that heavy job. However, there are still some market values for the sugar cane extractor to be designed in conventional method, which is using only mechanical power to operate it. It is special design for home users and some small business purpose, perhaps in villages with lesser population and demand.

1.3 Objectives

To design an efficient machine/mechanism that able to extract sugar cane juice by using only mechanical power.

1.4 Scope

The machine designed will be based on the studies conducted by referring to the existing sugar cane machine, whether it is pure mechanical power or semi-automated machine. And here are some scopes of the studies:

i. Conduct literature review.
ii. Design few conceptual designs that fulfill the engineering design specification.
iii. Conduct analysis on gear and other mechanical parts.
iv. Conduct simulation on how it works.

CHAPTER II

LITERATURE REVIEW

Under the chapter of literature review, it focuses on the studies that related to the project. All the theories, observations, surveys, recitations and also understanding of the documentations regarding the project are needed. These are for ensuring the project can be carried out in a better and smoother condition. Other information such as materials used, mechanism involved and software used for the purpose of analysis also will be included in this chapter.

2.1 History and Background of Sugar Cane

Sugar cane originated in New Guinea where it has been known since about 6000 BC. From about 1000 BC its cultivation gradually spread along human migration routes to Southeast Asia and India and east into the Pacific. It is thought to have hybridised with wild sugar canes of India and China, to produce the 'thin' canes. It spread westwards to the Mediterranean between 600-1400 AD. [1]

Arabs were responsible for much of its spread as they took it to Egypt around 640 AD, during their conquests. They carried it with them as they advanced around the Mediterranean. Sugar cane spread by this means to Syria, Cyprus, and Crete, eventually reaching Spain around 715 AD. [1]

Around 1420 the Portuguese introduced sugar cane into Madeira, from where it soon reached the Canary Islands, the Azores, and West Africa. Columbus transported sugar cane from the Canary Islands to what is now the Dominican Republic in 1493. The crop was taken to Central and South America from the 1520s onwards, and later to the British and French West Indies [1].

Figure 2.1: Sugar Cane [15]

2.2 Sugar in South Asia

Sugar cane has a very long history of cultivation in the Indian sub-continent. The earliest reference to it is in the Atharva Veda (1500-800 BC) where it is called Ikshu and mentioned as an offering in sacrificial rites. The Atharva Veda uses it as a symbol of sweet attractiveness.

Sugar cane was originally grown for the sole purpose of chewing, in southeastern Asia and the Pacific. The rind was removed and the internal tissues sucked or chewed. Production of sugar by boiling the cane juice was first discovered in India, most likely during the first millennium BC.