



**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**DESIGN AND DEVELOPMENT OF BOAT  
WINCH : EFFECT ON MACHINERY**

Thesis submitted in accordance with the requirements of the  
National Technical University College of Malaysia for the Degree of  
Bachelor of Engineering Manufacturing (Process)

By

**Mohd Khairul Najmi Bin Uyup**

Faculty of Manufacturing Engineering

April 2007


**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**
**BORANG PENGESAHAN STATUS TESIS\***
**JUDUL: DESIGN AND DEVELOPMENT OF BOAT WINCH : EFFECT ON MACHINERY**
**SESI PENGAJIAN : 2006/2007**
**Saya MOHD KHAIRUL NAJMI BIN UYUP**

mengaku membenarkan tesis (PSM/Sarjana/Doktor Falsafah) ini disimpan di Perpustakaan Universiti Teknikal Malaysia Melaka (UTeM) dengan syarat-syarat kegunaan seperti berikut:

1. Tesis adalah hak milik Universiti Teknikal Malaysia Melaka.
2. Perpustakaan Universiti Teknikal Malaysia Melaka dibenarkan membuat salinan untuk tujuan pengajian sahaja.
3. Perpustakaan dibenarkan membuat salinan tesis ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. \*\*Sila tandakan (✓)

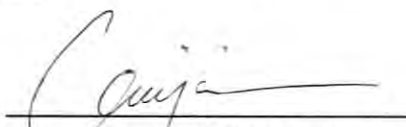
 **SULIT**

(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia yang termaktub di dalam AKTA RAHSIA RASMI 1972)

 **TERHAD**

(Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)

 **TIDAK TERHAD**

  
(TANDATANGAN PENULIS)

  
(TANDATANGAN PENYELIA)

Alamat Tetap:  
**NO 241, Jln Serengkam, 26500  
Maran, Pahang Darul Makmur**

Cop Rasmi:  
**MOHD. HADZLEY BIN ABU BAKAR**  
Ketua Jabatan (Proses Pembuatan)  
Fakulti Kejuruteraan Pembuatan  
Universiti Teknikal Malaysia Melaka  
Karung Berkunci 1200, Ayer Keroh  
75450 Melaka

Tarikh: 20 April 2007

Tarikh: 23/5/07

\* Tesis dimaksudkan sebagai tesis bagi Ijazah Doktor Falsafah dan Sarjana secara penyelidikan, atau disertasi bagi pengajian secara kerja kursus dan penyelidikan, atau Laporan Projek Sarjana Muda (PSM)  
\*\* Jika tesis ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh tesis ini perlu dikelaskan sebagai SULIT atau TERHAD.



**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

Karung Berkunci 1200, Ayer Keroh, 75450 Melaka

Tel : 06-233 2421, Faks : 06 233 2414

Email : fko@kutm.edu.my

**FAKULTI KEJURUTERAAN PEMBUATAN**

Rujukan Kami (Our Ref) :  
Rujukan Tuan (Your Ref):

20 Apr. 07

Pustakawan  
Perpustakaan Universiti Teknikal Malaysia Melaka  
UTeM, Ayer Keroh  
MELAKA.

Saudara,

**PENKELASAN TESIS SEBAGAI SULIT/TERHAD**  
**- TESIS SARJANA MUDA KEJURUTERAAN PEMBUATAN (PROSES PEMBUATAN):**  
**MOHD KHAIRUL NAJMI BIN UYUP**  
**TAJUK: DESIGN AND DEVELOPMENT OF BOAT WINCH : EFFECT ON**  
**MACHINERY**

Sukacita dimaklumkan bahawa tesis yang tersebut di atas bertajuk "*Design And Development Of Boat Winch : Effect On Machinery*" mohon dikelaskan sebagai terhad untuk tempoh lima (5) tahun dari tarikh surat ini memandangkan ia mempunyai nilai dan potensi untuk dikomersialkan di masa hadapan.

Sekian dimaklumkan. Terima kasih.

**"BERKHIDMAT UNTUK NEGARA KERANA ALLAH"**


Yang benar,

**EN HADZLEY BIN ABU BAKAR**  
*Pensyarah,*  
*Fakulti Kejuruteraan Pembuatan*  
*(Penyelia UTAMA)*

s.k. - **Penyelia Utama:**  
**P.S.SIVARAO**

## DECLARATION

I hereby, declare this thesis entitled “Design and Development of Boat Winch : Effect on Machinery” is the results of my own research except as cited in the reference.

Signature :  .....

Author's Name : MOHD KHAIRUL NAJMI BIN UYUP .....

Date : 20 APRIL 2007 .....

## APPROVAL

This thesis submitted to the senate of UTeM and has been accepted as fulfillment of the requirement for the degree of Bachelor of Engineering Manufacturing (Process). The members of the supervisory committee are as follows:



.....  
Main supervisor  
Faculty of Manufacturing Engineering

**MOHD. HADZLEY BIN ABU BAKAR**  
*Katua Jabatan (Proses Pembuatan)*  
Fakulti Kejuruteraan Pembuatan  
Universiti Teknikal Malaysia Melaka  
Karung Berkunci 1200, Ayer Keroh  
75450 Melaka

## ABSTRACT

This research discusses the application and component to build the boat winch. For project Sarjana Muda it consist of the beginning construction of a title “ developing of the Boat Winch : Effect on Winch.”. Here, the problem statement and the objectives of thus research have been identified. Beside that the scope of the important of the study, along with the outline of the study have been reviewed and discuss. As for the literature review, it consist the information and the article of academics in reference book and via internet, especially related with the titled. In this chapter, it has their histories, definition, terminology and techniques. The successful winch for any application will be able to repeatedly perform its required task for many years without compromise. Yet for all the modern tools and technology available to extend performance and efficiency. All sentences are discussed on the methodology, the step that had to use to make the boat winch will considered the best. The component size will be selected to make the good design.

## **DEDICATION**

*For my beloved mother and father*

## ACKNOWLEDGEMENTS

First and foremost, I would like to express my highest appreciation to my supportive academic supervisor, Mr.Hadzley B. Abu Bakar. His supervision and support that gave me truly helps during the period of conducting my thesis. His never-ending supply of valuable advice and guidance has enlightens me and deeply engraved in my mind.

Next, I would like to dedicate my thankfulness to the helpful of Mr. Shahir B. Kasim, as my second supervisor for his enthusiastic support and supervision of the thesis revision. I'm also happy to present my gratefully acknowledge to Machinery laboratory technicians, who has been so warmth and kind to provide sincere assistance and good cooperation during the training period. Their co-operation is much indeed appreciated. In addition, I would like to convey thanks to FKP lecturers, for their assistance, which really spends their time to teach me a lots of knowledge regarding to the design development.

Last but not least, I would like to state my appreciation to the staff – Faculty of Manufacturing Engineering, FKP, my friend and colleagues for supporting me and administration department for their help in the project . Thank you.



# TABLE OF CONTENTS

Abstract	i
Table of Contents	ii
List of Figures	iv
List of Tables	vi
1. INTRODUCTION	
1.1 Background	1
1.2 Problem Statements	2
1.3 Objectives of the Research	4
1.4 Scope of Study	4
1.5 Important of Study	5
2. LITERATURES REVIEW	
2.1 Introductions to Boat Winch	6
2.1.1 What is Winch	7
2.1.2 Developing the winch application	9
2.1.3 Material Of Choice	9
2.1.4 Which Winch	10
2.2. Type of Winch	12
2.2.1 Trailer Winch	12
2.2.2 Manual Boat Lift Winch/Crank Wheel	13
2.2.3 12-Volt DC Boat Lift Winch with Wired Remote	13
2.2.4 12V single Winch	14
2.2.5 Nautical Structures Deck Cranes	15
2.3 Component on Boat Winch	16
2.3.1 Gear System	16
2.3.2 Type of gear	17

2.3.3. Belting System (V-Belt	22
2.3.4 Electric motor	29
2.3.5 Electric Motor Application And Operation	31
2.3.6 Calculation formula for the Electric Motor	36
2.3.7 Bearing Types and Application Design, Ball Bearings, Roller Bearings, Thrust Bearings	39
2.3.8 Shaft Design and Analysis	45
2.3.8.1 Procedure for Design and analysis of a Shaft	46
2.3.8.2 Square and Rectangular Parallel Keys	50
2.4 Previous Boat Winch	52
3. METHODOLOGY	
3.1 Introduction	61
3.2 Overall of Methodology	64
3.2.1 Design Concept	65
3.2.2 Design for Assembly	67
3.2.3 Selection of Materials and process	67
3.2.4 Best Design Concept	.68
3.2.5 Design for Manufacture	68
3.2.6 Prototype	68
3.2.7 Suggestion for Simplification of product	68
3.2.8 Identification process	68
3.2.9 Detail Design for Minimum Manufacturing Coast	68
3.2.10 Production	69
3.3 PUGH METHOD	69
3.3.1 PUGH selection method boat winch	70
3.4 Embodiment Design	71
3.4.1 Material Selection for a New Product or New Design	71
3.4.2 Material Selection for Boat Winch	72
3.4.2.1 Cover	72
3.4.2.2 Gear	74

3.4.2.3 V-Belt	75
3.4.2.4 Shaft	75
3.4.2.5 Bearing	76
3.5 Manufacturing Process Selection	76
4.0 EXPERIMENT OF METHODOLOGY	
4.1 Design and Development Boat Winch	78
4.2 Development	78
4.2.1 Upper Base and Lower Base	78
4.2.2 Mounting	82
4.2.3 Drive shaft	86
4.2.4 Final Manufacture	88
4.3 Analysis	
4.3.1 AISI 1020	90
4.3.2 Analysis on Component	91
4.3.3 Von Mises Stress	92
4.4 Analysis and Result	
4.4.1 Monting Shaft	94
4.4.2 Key	97
5.0 DISCUSSION	
5.1 Overview of Analysis	100
5.2 Overview of Design	100
6.0 CONCLUSION	
6.1 conclusion	102
6.2 Recommendation	103
REFERENCES	73

## LIST OF FIGURE

1.1	Fisherman Boat	3
1.2	traditional way to pull the boat to seashore	3
2.1	The largest winch on earth	8
2.2	traditional winch	9
2.3	example of electric winch	11
2.4	trailer winch	12
2.5	manual winch (Crank Wheel)	13
2.6	wired remote	13
2.7	12v single winch	14
2.8	Deck Crane also known as boat lift winch	15
2.9	gearing system	16
2.10	Rotation on gear	17
2.11	cross section of worm gear	18
2.12	Spur gears	19
2.13	a) Helical Gear	20
	b)Cross Helical Gear	20
2.14	Bevel gears	21
2.15	Spiral bevel gears	21
2.16	Hypoid bevel gears in a car differential	22
2.17	V-Belt Section and sizes	24
2.18	V Belt Pulley Sheave Sizes	26
2.19	cross section of synchronous motor	31
2.20	cross section of stepper motor	33
2.21	rotor position	33
2.22	AC induction motor rotor	34
2.23	(a) schematic diagram for the single AC phase induction motor	36
	(b) phase diagram	36
2.24	variety of bearing	39

2.25	cross section of bearing	42
2.26	Gear, Pulley, Bearing Thrust Chart	42
2.27	miniature bearing small as pin	44
2.28	Thin-section bearings for robots	45
2.29	section in thin bearing	45
2.30	shows the geometry of the shaft	50
2.31	show the application of key and key seat at a hub and shaft	52
2.32	Boat winch available at Pantai Kundur	53
2.33	single phase electric AC motor.	53
2.34	specification of electric AC motor	54
2.35	Power source for winch 1	54
2.36	wired steel cable	55
2.37	winch at the back view.	55
2.38	Component install on the winch	56
2.39	the other side of winch side	57
2.40	AC electric motor with 240V power supply	58
2.41	roller bar for conduct the wire rope in order.	58
2.42	gear are used on winch 2	59
2.43	coupling	59
2.44	switch to control front and backward of steel wired rope	60
3.1	flow chart	63
3.2	Typical steps taken in a design a boat winch	64
3.3	design 1	65
3.4	design 2	65
3.5	design 3	66
3.6	design 4	66
3.7	design 5	67
4.1	Mild Steel Plate (10mm)	80
4.2	Laser Machine Control Panel	81

4.3	Placement Material	81
4.4	Cut The Material	82
4.5	Base	82
4.6	Milling Machine	84
4.7	Bend Saw	85
4.8	End Mill	85
4.9	Mounting	86
4.10	(a) Cutting Process	87
	(b) Key Way	87
4.11	Shaft	88
4.12	Assembly of Boat winch	89
4.13	Green Line Show the Restraint Part	95
4.14	Stress Result	96
4.15	Displacement Result	96
4.16	Design Check Result	97
4.17	Restraint	98
4.18	Stress Result	98
4.19	Displacement Result	99
4.20	Design Check Result	99

## LIST OF TABLE

2.1	Standard Groove (Sheave) Widths	25
2.2	Face width of sheave	25
2.3	Groove dimension in inches and face width of sheave	26
3.1	PUGH Method Selection	70
3.2	Manufacturing Process	77
4.1	AISI 1020 Properties	90
4.2	Mechanical Properties	90
4.3	Material Mounting	94
4.4	Material Key	97

## APPLIED FORMULA SYMBOLS

The applied formula symbols are corresponding with those used in the DIN standard.

$a_1$	-	factor for failure probability
$a_{23}$	-	material and lubrication factor
$B$	mm	bearing width
$C$	N	dynamic load rating
$C_0$	N	static load rating
$d$	mm	bore diameter
$Da$	mm	outside diameter
$e$	-	decisive characteristic for $\frac{F_a}{F_r}$ to select the factors $X$ and $Y$
$F_a$	N	axial applied bearing load or axial component of the real applied bearing load
$F_r$	N	radial applied bearing load or radial component of the real applied bearing load
$L$	$10^6$ rev	nominal fatigue life of the bearing measured in $10^6$ revolutions
$L_{10}$	$10^6$ rev	rated design life measured in $10^6$ revolutions
$L_h$	h	nominal fatigue life of the bearing measured in hours of operation
$n$	1/min	operating speed
$\eta$	$mm^2/s$	operating viscosity of the oil or base oil
$P$	N	equivalent dynamic load
$P_0$	N	equivalent static load
$t$	$^{\circ}C$	operating temperature in the bearing



$V$	-	contamination factor
$VG$	$mm^2/s$	viscosity class due to DIN 51 519 (conforming with the kinematic viscosity at 40°C)
$X$	-	radial factor of the dynamic load
$X_0$	-	radial factor of the static load
$Y$	-	axial factor of the dynamic load
$Y_0$	-	axial factor of the static load
$Zu_{req}$	%	required reliability of the computed design life $L_h$ or $L$

Used equations

**Note:**

All specified formulas are numerical equations, which are only valid, if the values in the unit measures indicated above are put into the formulas.

# CHAPTER 1

## INTRODUCTION

### 1.1 Background

In now days, there are less improvement to our local fisherman. There were still in used of old method that been used for a very long time ago. Their still used their strength to pull out the fish from the boat or their still used the old method to pull out the boat from the water to the shore. This is to prevent the damaged by effect from the salt water of the sea. If the boat are not pull out from the sea, it will make corrosion and it will make the boat are not safe to use and it need to repair. The design concept is according to the problem statement that will be discussed below.

At Pantai Kundur where is the local fisherman based. There is already having the Boat Winch. In this concept, it needs to reduce the cost but still effective. Then the power of pull strength will increase according the boat that will be pulling out. In the literature review it will be discuss the selection of gear that been used by the local supplier and the best selection will be take part of the designing the product.

The Boat Winch are used to pull out the boat without used human strength but just need the electricity and the mechanical strength to pull the boat out from the sea. This will make a lot easier than used old method and it will save the time and energy from exhausted. The main method that been

used for the boat winch are the how much load that the winch can be pull and the product, that can be the human technology that is how the user friendly and how much the boat can be pull from the one base. The purpose to develop a new design for a boat winch are to reduce the machining cost with the machine that easy to use. The machine that used for machining is such as the Lathe Machine, Milling machine are used to mill the part that will hold the component and the other machine that will make the cost for machining are low. The survey from past invention is costly and it's limited to user only one user can use at one time.

## **1.2 Problem Statement**

Usually, fisherman always load their catch to the seashore before bring all the fishing goods to the port, some of them directly to the fishing port. There is some method to transfer the boat from sea to the seashore. In traditional way, there will used power of man. They need six or more men to pull the boat to seashore. The situation still available at most of the fisherman place at Malaysia. The improvement is done to make easier to them pull the boat to the seashore. Some of them are developing the boat winch to carry out the load of boat and pull the boat to the fishing port. But, there were high cost to develop the machine installment and maintenance limited the used of the machine especially to the small fisherman.



Figure 1.1: Fisherman Boat



Figure 1.2: traditional way to pull the boat to seashore

### **1.3 Objectives**

The main objectives of this research are an attempt to create a prototype of a boat winch and compare with the already made boat winch that available at Pantai Kundur. Beside that, other specific objectives include:

- i. To develop the Boat Winch
- ii. Better understanding about the mechanism of building the prototype.
- iii. Contribute to knowledge of machinery, for better design of the product.

### **1.4 Scope of Study**

This research and development is focus on the already made boat winch at the Pantai Kundur, Malacca. Malacca is located about 120km from Kuala Lumpur; in the Malacca fishing is the main income of some the villagers at the seashore. There were some fishing port at the seashore and already install with the boat winch. In the interview, the cost of one boat winch is about RM3+++ . But there still had a problem occurred to the winch. Most of the fisherman still had problem to drag their boat to the fishing port causes of the sand and the load of that boat itself. Some of the fisherman can effort the boat winch but the application is limited to one person and one boat winch only. So this research and development is to help the fisherman that has average income, effort to buy the boat winch. If they share with two or three person, maybe the cost is not a problem for them. For this, it must have limit user of two or three person per boat winch and the cost is lower from the product available at the market.

## **1.5 Importance of Study**

The importance of the study is to research and development or improves the already made product that available at the market. Base from the research and the calculation the best part will be select and the design will be build to make the boat winch. The mounting also is one of the researches because they need to pull more than one boat per boat winch. This will be considering the base of mounting and the power needed to pull the boat with or without good from their catch. Base of all these, an ideal machine for the fisherman for the specific type of boat may be build, thus will reducing work – related injuries, improve quality and productivity and improve the quality of the boat and fisherman themselves.

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.1 Introduction**

The singularly most common equipment used between all ocean-related applications, in everything from pleasure sailing to core sampling, including oceanographic work in practically every aspect of the field would have to be use the winch. This seemingly insignificant and often-taken-for-granted piece of machinery is used for everything from hauling-in the jib or mainsail to anchoring ships or towing barges, to handling oceanographic instruments. Look around and you may appreciate that winches are literally used everywhere in all applications. This particular article will be limited to the performance and design aspects of science winches which are used in oceanographic applications where winches are required to spool hundreds and thousands of meters of expensive cable perfectly every time.

Winches are often required to precisely monitor various operating conditions such as cable payout length, speed, tension and are often called upon to provide such features as active motion compensation, integrated cable cleaning systems, remote control, and computer interface. Increasingly

sophisticated cable technology and expensive payloads have made the handling requirements for these seemingly unimportant machines even more critical. Yet among many discussions concerning deepwater instrumentation deployments and sampling casts or tows, who has ever been heard talking about the winch that was used in these successful applications. How about the winch that outlived the vessel it was on?

From a distance, today's winch looks a lot like its ancestor of the past (after all there is just a motor and a spool, right?) but a closer look reveals major improvements in the drive systems, cable handling, safety and reliability that utilize the best and most advantageous advances in technology like the systems they are called on to support. The improvement in drive technology, both hydraulic and electric, has had a profound impact on the winch system of today.

### **2.1.1 What is winch?**

A winch is a mechanical device that is used to wind up a rope or cable. In its simplest form it consists of a spool and attached crank. More elaborate designs have gear assemblies and can be powered by electric, hydraulic, pneumatic or internal combustion drives. Some may include a solenoid brake and/or a mechanical brake or ratchet that prevents it from unwinding. (boat Us, 2006)

Besides industrial applications (e.g. in cranes), winches are used for towing cars, boats, or gliders. There are several winches on almost every boat or ship where they are used to pull anchor or mooring lines, halyards, and sheets.

The rope or cable is usually stored on the winch, but a similar machine that does not store the rope is called a capstan. Winches are frequently used as