

DESIGN AND FABRICATION OF MULTI PURPOSE LADDER

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Requirements for the award of the Diploma  
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### **SUPERVISOR DECLARATION**

“I declare that I have read this thesis and in my opinion, this thesis is enough to fulfill the purpose for the award for the Diploma of Mechanical Engineering from the aspects of scope and quality.”

Signature : .....

Supervisor : En. Idris Bin Mat Sahat

Date :

## STUDENT DECLARATION

I declare that this report entitled “*Design and Fabrication of Multi Purpose Ladder*“ is the result of my own research except as cited in the references. The report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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## ABSTRACT

The idea to design and fabricate a multi purpose ladder is come from a supervisor that gives a task and a title for this project. To design and fabricate this multi purpose ladder, the existing product in market must be compared first to know the latest designs that have been created. The information about current design for multi purpose ladder must be search or find from magazine, newspaper, catalog or internet. From all the information, idea to design and fabricate can be created. It includes many things about multi purpose ladder that want to be design such as portable and foldable. This because, some of the current ladder is heavy, uses a lot of space to stored and not stable.

The whole of the project involve various methods like the concept design, the designing and also the fabrication process. After the fabrication process is completed, the multi purpose ladder is tested to make sure the product is functional and achieves the objectives successfully.

Overall, this project can bring a motivation and experience, train to work under the pressure, apply knowledge that have been learned and soft skill ability like time management, planning the task, and negotiation skill to make sure this project goes smooth as plan and done at correct time.

## ABSTRAK

Idea untuk merekabentuk dan menghasilkan tangga berbagai guna telah dikeluarkan oleh penyelia yang memberikan tugas. Untuk merekabentuk dan menghasilkan tangga berbagai guna ini, tangga yang telah wujud di pasaran mestilah di bandingkan dahulu untuk mengenalpasti rekabentuk yang terbaru yang telah wujud. Maklumat mengenai rekabentuk semasa untuk tangga berbagai guna perlu dicari atau didapati dari majalah, suratkhbar, katalog atau internet. Daripada semua maklumat, idea untuk merekabentuk dan menghasilkan boleh tercipta. Ia merangkumi banyak benda mengenai tangga berbagai guna yang hendak dihasilkan seperti mudah dibawa dan boleh dilipat. Ini kerana, sesetengah tangga dipasaran adalah berat, menggunakan ruang yang banyak untuk disimpan dan tidak stabil.

Keseluruhan projek ini melibatkan pelbagai kaedah seperti konsep rekabentuk, merekabentuk dan proses penghasilan. Selepas proses penyambungan selesai, tangga berbagai guna tersebut diuji untuk memastikan product yang dihasilkan berfungsi dan memenuhi objektif.

Secara keseluruhannya, projek ini boleh memberikan motivasi dan pengalaman, melatih untuk bekerja dibawah tekanan, mengaplikasikan ilmu yang telah dipelajari dan dalam keupayaan kemahiran insaniah seperti pengurusan masa, merancang tugas, dan kemahiran berunding untuk memastikan projek ini berjalan lancar mengikut perancangan dan siap pada waktunya.

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**LIST OF SYMBOLS**

<i>ft</i>	Feet
<i>psi</i>	Pounds per square inch
<i>lb</i>	Pounds
<i>in</i>	Inch
<i>kg</i>	Kilogram
<i>m</i>	Meter
<i>pcs</i>	Pieces
<i>mm</i>	Millimeter
<i>N</i>	Newton
<i>%</i>	Percent
<i>F</i>	Force
<i>M</i>	Moment
$\sigma$	True stress, local stress
<i>I</i>	Inertia
$\gamma$	Distance between center to tube

## **CHAPTER 1**

### **INTRODUCTION**

#### **1.1 INTRODUCTION**

This final year project involves designing, fabricating a functional ladder with extra new features and some analysis. This prototype could be use by the other lecturers or students in lab. As the Diploma final year, this project allocates the duration of one semester and it's focused to create the functional prototype.

#### **1.2 PROJECT SYNOPSIS**

The project title is fabricating a Multi Purpose Ladder. The project involves the survey and analysis about current design of multi purpose in current market. This ladder should be able to fold to make it easier to storage. Its also must be portable to bring it anywhere. Tests are required to be conducted and to verify the design. This project development must be concern with material strength, type of material, connection of folding and part of the structure.

#### **1.3 PROJECT BACKGROUND**

Nowadays, ladder becomes the common facilities for human. There are much type of ladder in the world wide market such as fixed ladder, extension ladder, step ladder, orchard ladder and others.

The main purpose of multi purpose ladder is to help human to do their work especially at the high place that can't be reach and help them to keep it without using

a large space. Its can reduce time, increase efficiency and reduce space to store. As the result for the needed in community there are many various type of multi purpose ladder had been invented. Multi purpose ladder can foldable, portable and easy to use. It also comes in many sizes and design to make customer to choose which one is more suitable for them.

From the advantages and disadvantages of the ladder in the world wide market, one new product design will be create. This ladder can hold maximum weight 150kg, can be fold and portable.

#### **1.4 PROBLEM STATEMENT**

As we all know, ladder is one of the important thing to help human to do their job at the high place but most of it is big, hard to bring and need a lot of space to store. Furthermore, each ladder has its own use and specific use. It's limited to do other job than the specification. Some of ladder is not long lasting. To reduce this problem, one product must be created to fulfill the customer needed.

#### **1.5 PROJECT OBJECTIVE**

##### **1.5.1 General Objective**

Diploma final year project is to practice the knowledge and skill of the student that have been learned in their first and second year as a Diploma Mechanical Engineering student. It's important to born an engineer that have enough knowledge and engineering skills.

This project is important to train and increase the student capability of research, data gathering, analysis making, improving skills and then problem solving.

The project will train the student communication skills for example in presentation where they have to defend their research compare to other existing



products. They also have to deal with a lot of people to fabricate the product for example with En. Hazami Bin Che Hussain and En. Mohd Rizal Bin Mat Ali.

The project also will generate the students capability to make a good research report in thesis form or technical writing besides choosing the suitable material for their product.

This project otherwise can produce and train student to capable of doing work minimum supervision and more independent in searching.

In fabrication process, the students will learn more deeply in how to using a tool or equipment and method to fabricated the projects.

### **1.5.2 Specific Project Objective**

The main objective of this project is:

- i. To design and fabricate a functional multi purpose ladder.
- ii. To create extra new feature, creative and innovative design.
- iii. Can hold maximum weight 150kg.
- iv. To design and fabricate the prototype of multi purpose ladder based on mechanical engineering method

### **1.6 PROJECT SCOPE OF WORK**

This project is about design and fabricates a new product of ladder that has multi purpose. Design for this product is consider from the available product in the world wide market. Base on the advantages and disadvantages one new product will be creating to reduce the disadvantages and add more advantages facilities.

- i To apply all related subject like industrial design, static and dynamic in the product design and strength analysis (failure analysis).

- ii Conceptualization is to concentrate creating the product form using simple sketch.
- iii Final concept selection is to draw in 2D(AutoCAD) or 3D(SolidWork) often used for color studies and for testing the products feature and functionality.
- iv ladder must have multi purpose.

## 1.7 GANTT CHART

Project Activities		Week													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
literature review	Plan	█	█	█	█	█	█	█	█						
	Actual	█	█	█	█	█	█	█							
Idea Generation/Designing	Plan			█											
	Actual			█											
Finalized Concept and Selecting Material	Plan				█	█	█	█							
	Actual				█	█	█	█							
Fabrication	Plan							█	█	█	█				
	Actual							█	█	█	█				
Result & Finding	Plan									█	█				
	Actual									█	█				
Discussion/ Conclusion	Plan											█			
	Actual											█			
Slide Preparation/ Presentation	Plan												█	█	
	Actual												█	█	
Report writing	Plan				█	█	█	█	█	█	█	█	█	█	
	Actual				█	█	█	█	█	█	█	█	█	█	
Submit Report and Final Presentation	Plan														█
	Actual														█

Table 1.1: Gantt chart

## CHAPTER 2

### LITERATURE REVIEW

#### 2.1 INTRODUCTION

A ladder is a steps consisting of two parallel members connected by rungs; for climbing up or down. It is ascending stages by which somebody or something can climb the ladder. There are two types: rigid ladders that can be leaned against a vertical surface such as a wall, and rope ladders that are hung from the top. The vertical members of a rigid ladder are called beams (US) or stiles (UK). Rigid ladders are usually portable, but some types are permanently fixed to buildings.

Rigid ladders are available in many forms, such as:

- Extension ladder- fixed ladder divided into two or more lengths for more convenient storage; the lengths can be slid together for storage or slid apart to maximize the length of the ladder; a pulley system may be fitted so that the ladder can be easily extended by an operator on the ground then locked in place using the dogs and pawls
- Step ladder- hinged in the middle to form an inverted V, with stays to keep the two halves at a fixed angle
  - Platform steps- step ladder with small horizontal platform at the top
- Orchard ladder- three legged step ladder with third leg made so that it can be inserted between tree branches for fruit picking
- Telescopic ladder- stiles consist of concentric or rectangular tubing that can be slid inside each other for storage

- Hook ladder- rigid ladder with a hook at the top to grip a windowsill; used by firefighters

## 2.2 HISTORY OF LADDER

Ladders are ancient tools and technology. A ladder is depicted in a Mesolithic rock painting that is at least 10,000 years old, depicted in a cave in Valencia, Spain. The rock painting which shows two naked humans carrying baskets or bags that are employing a long wobbly ladder, which appears to be made out of some kind of grass, to reach a wild honeybee nest to harvest honey. Modern ladders are believed to have been conceived by Hebrews and Egyptians.

## 2.3 COMPARISON OF CURRENT DESIGN

In this project, seven current designs are selected to make a comparison. This comparison is specific to advantages and disadvantages for each current design from basic ladder until multi purpose ladder.

### 2.3.1 Fixed Ladder



Figure 2.1: Fixed Ladder

Source: Clow Group LTD

### Advantages

- The price is cheap
- Durable
- Simple shape

### Disadvantages

- Not adjustable high
- Cant be move
- Fix shape( cant be form into other shape)
- Fix to the wall

## 2.3.2 Step Ladder



Figure 2.2: Step Ladder

Source: Clow Group LTD

### Advantages

- Stable to use
- Foldable to store

- Durable

#### Disadvantages

- Heavy to lift
- Not for high place maintenances job
- Difficult to carry
- Use a lot of space to store
- Only one side can be use(have rungs)
- Fix for one angle

### **2.3.3 Extension Ladder**



Figure 2.3: Extension Ladder

Source: Clow Group LTD

#### Advantages

- Retractable and extendable
- Suitable for high and medium high place for maintenances job

#### Disadvantages

- Not stable to used
- Heavy to lift

- Difficult to carry to other place
- Must be silted to the wall to used
- Basic shape of the design

#### 2.3.4 Multi Purpose Folding Ladder



Figure 2.4: Multi Purpose Folding Ladder

Source: Clow Group LTD

##### Advantages

- Foldable
- Stable
- Adjustable high (can be form into many shape for different high)
- Did not use a lot of space to store

##### Disadvantages

- Heavy
- Difficult to bring

### 2.3.5 Telescopic Ladder



Figure 2.5: Telescopic Ladder

Source: Clow Group LTD

#### Advantages

- Adjustable for high and medium high place for maintenances job
- Foldable
- Stable to use because the base part is more width
- Light weight (easy to lift to other place)

#### Disadvantages

- Large and hard to keep or stored
- Difficult to lift to other place

### 2.3.6 Assault Ladder

These are designed to be used by units which may need to board or assault vessels or buildings. They can be used when a full sized ladder is not required or when working in confined spaces. Suited for covert operations such as sniper placement, and vessel boarding. It was developed and designed for tubular assaults including buses and trains and for 1st story breaching. Its extra wide design gives the