UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DESIGN AND DEVELOP A STAIR CLIMBER TROLLEY

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

by

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ABSTRAK

Dunia sekarang penuh dengan pelbagai teknologi yang ganggih dan berkualiti tinggi. Dengan itu, pelbagai produk akan dapat dihasilkan untuk memberi keselesaan kepada pengguna. Di dunia yang serba canggih ini juga masih terdapat segolongan penduduk yang masih beroindah randah kerana pekerjaan mereka. Oleh itu, banyak pangsapuri dihasilkan bagi memuatkan bilangan penduduk di sekitar bandar yang kecil seperti bandar Kuala Lumpur dan juga Melaka. Kebanyakan pangsapuri yang tinggi mempunyai lif tetapi sekiranya pangsapuri tersebut hanya sekadar mempunyai tiga hingga empat tingkat, pangsapuri tersebut tidak mempunyai lif. Ini membuatkan kebanyakan penduduk sukar untuk membawa barang yang besar dan berat ke tingkat atas. Dengan adanya Stair Climber Trolley, ia dapat membantu mengurangkan beban kepada penduduk semasa membawa barang ketika menaiki tangga. Idea ini telah dilukiskan dalam peirisi Catia bagi mengambarkan lagi ukuran yang sesuai dan difabrikasikan menggunakan kimpalan arka dimana dapat menguatkan dan mengukuhkan lagi troli tersebut. Dengan gabungan pulley dan tali penghawa dingin yang dipasang pada belakang troli tersebut, sedikit sebanyak dapat membantu troli untuk pengguna menarik dan menolak troli tersebut.

ABSTRACT

The world is recently full of great and high-quality technologies. Thus, a variety of products was producing to provide convenience to consumers. In this indispensable world there are still a group of people who are still struggling because of their work. Therefore, many apartments were produced to accommodate the population of small towns such as Kuala Lumpur and Melaka. Most high-rise apartments have lifts but if the apartments have only three to four floors, the apartments have no lift. This makes most people hard to carry large and heavy goods to the top floor. With the Stair Climber trolley, it helps to reduce the burden on residents when carrying things when going up the stairs. This idea has been described in Catia's Software to illustrate again the appropriate size and to be used using arc welding that can strengthen and reinforce the trolley. With a combination of pulley and air-conditioning cord mounted on the rear trolley, a little bit can help the trolley to pushing and pulling the trolley.

DEDICATION

I dedicated my dissertation work to my family. A special feeling of gratitude to my loving parents, Wan Zainul Abidin Bin Wan Abdullah and Norizan Mat Daud who always support me in finish my final year project.

I also dedicate this dissertation to my friends who have supported me throughout the process. I will always appreciate all they have done especially Mohd Zharif Bin Ghani for helping me in fabrication process.

I dedicate this work and give thanks to my supervisor and co-supervisor, Mr Mohd Hafizi Bin Abdul Rahman and Mr Mohamad Rafi Bin Omar and all UTeM lecturers. Thank you for always giving me guidance and persistent help to complete this final year project.

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INTRODUCTION

1.0 Introduction

A trolley as shown in figure 1.1 also known as a hand truck, dolly, two wheeler, stack truck, trundler, box cart, trolley truck, sack borrow, sack truck or bag borrow. According to Collin English Dictionary, hand truck or trolley is a small L-shaped handcart to transport heavy object by using two wheels and two handles. Trolley helps people to carry their goods more easily and prevent from back pain. It is not easy for people to carry their heavy goods in a considerable distance without trolley as shown in figure 1.2 below.

Figure 1.1 Current Trolley

Figure 1.2 Without using Trolley

Trolley is an upright framed of material handling equipment with large wheels that allow placing them under a load such as a stack of boxes or a large drum and tilting back on the trolley which allows rolling the load freely where it needs to go. There are many type and of trolley nowadays such as medicine trolley, hotel service trolley, shopping trolley and many more. More than one trolley has difference styles and maximum capacities exist.

Most of the people live in apartment which is use stair and there are many goods to carry and some of them use trolley to carry their goods. But there is become a problem for current trolley to climb the stair without addition of wheels such that shown in figure 1.3. In using a current trolley, it is can make people having a back pain while going up and down the stair. Example of several part that having back pain while using a current trolley in order to climb the stair as in figure 1.4.

Figure 1.3 Without Additional Wheels

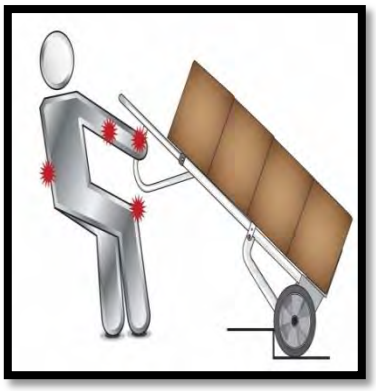

Figure 1.4 Several Part of Back Pain

In solving this problem, a stair climber trolley will be creating. According to Dictionary.com, stair is the step to climb from one level to another level such as in a building. Besides, climber is a climbing of the person or things and trolley is a moving handcart with by using two wheels and two handles. Develop and design a stair climber trolley which is helps people who live at the higher level of apartment to carry theirs goods easily. This product helps people to save their energy while going up and down the stair. Besides, people can reduce their back pain. This trolley will be modifying by using variable size of raw material. The automotive concept that will be used is the combination of V-belt and 2 pairs of air Cond pulley than will merge together with the regular trolley that helps to going up and down the stair. The suitable size of pulley and belt will be chosen to make sure the movement of trolley is smooth and comfort with the weight of trolley. In addition, this product can be folded and safe to be use.

1.1 Problem Statement

Nowadays, most of the people live in the apartment. As known that the apartment has more than one level and it might be difficult for peoples to carry their goods. It would be inconvenient when the broken lift suddenly happen. People now forced to be nomadic and need to rent in the apartment because of their jobs. And not everyone have enough money especially in these economic now.

1.2 Objective

The objectives of this research were as follows:

1. To design and optimize a stair climber trolley by using Catia Software.
2. To develop the finalize concept of stair climber trolley by using machining process and handmade.

1.3 Scope

The project of develop of stair climber trolley consists of 2 main stages which are design & optimization stage and fabrication stage.

In design stage, the first thing that has to do is benchmarking design. In this part, the information either in survey, separate the survey form, internet, social media or printed media must be collected to choose at least five selection of designs in market including specification, weight, material, cost and functionality as an idea for develop a stair climber trolley. Secondly is concept and optimize design. In concept design which comprises five hands sketching including with advantages and disadvantages of the sketching through product design specification (PDS). This concept selection process is a decision that make from weighted rating method. From that, all the materials and costs have been analysed and final design will be construct. For design process, Catia Software will be chosen as the 3D drawing in this project. There are variable type that will be design by using Catia Software such as part of mechanical component and its mechanism. The strength of frame or chassis of stair climber trolley sustained to 15 kg of load.

Furthermore, fabrication stage is an important thing that parallel with an objective of this project. In this project, welding, drilling, cutting and grinding process will used to fabricate and assemble the stair climber trolley and paint spray use to resist rust and corrosion in finishing process.

CHAPTER 2
LITERATURE REVIEW

2.0 Introduction

This chapter review on design trolley either locally or abroad of market, type of steels including carbon steels, alloy steels, tool steels, and stainless steels. Besides, process and selection of joining including brazing and soldering, mechanical fastening and welding process also need to be taken in develop a product and know the function for each type of process that involve.

2.1 General Engineering Design Process

Engineering design process is a step that must follow by the engineers to come up with a solution to a problem. The step such as define the problem, make some background research, do specify requirements, make a brainstorm solutions, choose the best solution, do development work, built a prototype, and lastly, test and redesign. Engineering design also can be known as designs that use variable type of engineering software. Engineering software such as Catia Software, Solid Work Software and CAD Software is the type of software design.

Over 50 years of practice of Software Engineering (SE) that has needed to be practice and shaped and it is discipline. Driven primarily by the needs of industry, a theoretical basis has been slow to develop. The theories of the Software Engineering are one of the addresses significant with the question in Software Engineering. The existing theories tend to be small, addressing limited sets of phenomena, very often implicit and only casually introduced by authors, with little academic discussion or rigorous evaluation within the community are the main criticisms of Software Engineering. Undoubtedly, their arguments have stirred some debate in the wider Software Engineering community, and perhaps have been the catalyst for a renewed interest in the theoretical foundation of the discipline. (Hall and Rapanotti, 2017)

Software Engineering can be easily when taking the 'software-as-artifice' such as that software is the sole artifice implies that the environment has a particular form, one in which software causes become physical effects, and vice-versa. Besides, the software is not the precise combination of solution technologies that will ultimately satisfy the need, even less that software will be the sole solution technology. (Hall and Rapanotti, 2017)

Moreover, Software Engineering design has a strategies that are refer to combined design processes that a company that should take for a specific purpose with particular conditions. However, little is known from empirical evidence about how these two strategies are applied in projects in industry. There have been few attempts to view the design process from an integrative perspective of engineering design and industrial design. In this regard, the collaborative design processes of both disciplines in the industrial context must to investigate first. (Kim and Lee, 2016)

One of the stages that are important in engineering design is optimization process. The availability and affordability of high speed computers are become this process so popular among the multi engineering design activities. This optimization process is usually used in aerospace design activities which to minimize the overall weight and simply. Minimize the weight of the aircraft components also one of the major in aerospace designers. Optimization process is discipline to optimize some specified set of

parameters without violating some constraint. Minimizing the cost and maximizing the efficiency is the goal of the optimization process in design process. There are two type of function of optimization process either for minimization the problem or maximization the problem. The modified software needs to be compiled before it can be used for the simulation. This can be done by using a discovering the critical activities and bottlenecks, using a process of mining tool, and acting only on them. (Deb, 1998)

2.2 Design Trolley in Market

Trolley is the one of the cart that very useful to help people in carry their goods wherever their go. There are many type of trolley available in the market. More than one design of trolley that is unique and attractive that has in the market which is different in size, functionality, materials, specification and cost.

One of the trolleys is Tyke Supply Stair Climber Aluminum Hand Truck Commercial Quality as shown in figure 2.2a which is a stair climber trolley. Tyke Supply manufactured it. This stair climber trolley can be functioned only by using hand to push and pull the trolley to moving it up and down the stair. This product has their intensity which is light weight and heavy duty. It is use aluminum as the material. The dimension of this product is 60 x 19.2 x 26.3 inches (1524 x 487.68 x 668.02mm). This product have 6 ¼" solid rubber for each tires, use 2 handles, 18" wide x 7.5" deep of nose plate and 40pounds (18kg) in weight. This product has been selling in price of $169.99 or RM752.29 each. (Tyke, 2017)

Figure 2.2a Tyke Supply Stair Climber Aluminum Hand Truck Commercial Quality

Next is Safco Products 4069 Tuff Truck Continuous Handle Utility Hand Truck (figure 2.2b) which a current trolley in the market. It was manufactured by Safco products. It can be functionally use by hand to moving. This product is the heavy gauge tubular steel frame with welded joints and durable powder coat as the finishing. It is ideal for one or two handed use. The capacity load of the goods is about 400lbs (180kg). Steel is the material that use in this trolley. It is 8" solid rubber wheels with ball-bearings and 20 pounds (9kg) in weight. The dimension of this product is about 14.2 x 19.3 x 45.5 inches (360.68 x 490.22 x 1155.7 mm). This current trolley is sale in price by $86.00 or RM 380.60 each. (Safco, 2017)

Figure 2.2b Safco Products 4069 Tuff Truck Continuous Handle Utility Hand Truck

Cost of the Magliner HMKF11AAA5 Aluminum Hand Truck as shown in figure 2.2c below that was manufactured by Magliner is about $205.95 (RM 929.13) for each trolley. This is a stair climber trolley and also uses hand to push and pull the trolley to moving up and down the stair. The attractive of this product is having curve back frame with vertical strap and horizontal loop handle. The capacity of load is about 500lbs (227kg). This product was use aluminum as the material of the trolley. It is use 14" wide x 7-1/2" deep of nose plate. The dimension of this trolley is 7.5 x 40 x14 inches (190.5 x 1016 x 355.6 mm). (Magliner, 2012)

Figure 2.2c Magliner HMKF11AAA5 Aluminum Hand Truck

Besides, the figure 2.2d below show the Steprider 1800 Stairclimbing Hand Truck was manufactured by The Step Rider is control by the remote which powered by AC and DC current This is operates as a stair climber as well as a horizontal mover. The innovation of this trolley is use 9 wheels swivel dolly, have battery and charger, and have ratchet and safety strap, quad wheels and control by the remote tethered cable. The capacity of load for this trolley is 1800lbs up and down stirs, and 2700lbs in horizontal. The materials use is steel and aluminum while the dimension is about 80 x 25 x 14 inches (2032 x 635 x 355.6mm). It is cost about $6199.99 (RM 27438.06) in weight of 148pounds or 67kg. (Steprider, 2017)

Figure 2.2d Steprider 1800 Stairclimbing Hand Truck

In addition, Magliner GMK81UA4 Gemini Sr Convertible Hand Truck, with pneumatic wheels as shown in the figure 2.2e below was manufactured by Magliner. The cost of this product is about $299.00 (RM1318.44). This trolley has 2 in 1 truck converts from 2 to 4 wheels in seconds. It is also have high capacities of reduce number of trips per day and increase the productivity. This product is strong and lightweight construction, so it is can reduces user fatigue. Modular design means no welds to break and all parts are replaceable longer the life of product. This trolley also have lowers driver fatigue which reducing the muscle strain. Load capacity for this Magliner trolley is 500 pounds (227kg). Aluminum is the material chose for this trolley. This trolley is 21" Wide x 61" H x 55-3/4" L in size and 48.8 pounds (22kg) in weight. (Magliner, 2012)