

**DESIGN, SIMULATION AND ANALYSIS OF CLIMBING TROLLEY**

**TURKESWARAN A/L SELADORAI**

**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**DESIGN, SIMULATION AND ANALYSIS OF CLIMBING TROLLEY**

**TURKESWARAN A/L SELADORAI**

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**This report is submitted  
in fulfilment of the requirement for the degree of  
Bachelor of Mechanical Engineering**

**Supervisor: EN. FAIZIL BIN WASBARI**

**Faculty of Mechanical Engineering  
Universiti Teknikal Malaysia Melaka**

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## DECLARATION

I hereby state that I have read through this report which the title is “Design, Simulation and Analysis of Climbing Trolley” is the result of my possess work but as cited within the references.


Signature : *turkeswaran* .....

Name : TURKESWARAN A/L SELADORAI .....

Date : 11/8/2020 .....

## APPROVAL

I state that I have read this report and, in my view, that this report is adequate in term of scope and quality for the grant of the degree of Bachelor of Mechanical Engineering.

Signature :  .....

Name of Supervisor : Faizil bin Wasbari .....

Date : 25 August 2020 .....

## **ABSTRACT**

First trolley model evolved long back in eighteenth century. However, fast improvement in this field began in the middle of twentieth century. Many types of models had been designed, extending into broad range of products. That is the reason to further develop the next generation trolley. The aim of this project is developing a mechanism for easy transportation of heavy loads over stairs. The requirement for such a system arises from regular needs in our society. Devices like hand trolley are used to relieve the stress of lifting whereas on flat ground; however, these devices sometimes fail once it involves carrying the load over short flight of stairs. In the light of this, the project makes an attempt to design a stair climbing hand cart which may carry heavy objects up the stairs with less effort compared to carrying them by manually. It is important to review the commercial viability and importance of such a product. A few designs were considered that would permit a non-industrial hand trolley to go over stairs, curbs, or uneven terrain while reducing the strain on the user. In our project, the stair climbing trolley manually is equipped with rubber excavator base wheels which enable us to carry load up and down the stairs. The rubber base set out to modify an existing product that would be easy to assemble and use. The design primarily involved processes like brainstorming, creating conceptual sketches, making CAD modelling. It additionally eases movement of trolley in irregular surface like hole, bumps, etc. At the end, the design of stair climbing trolley has been produced in Autodesk 3ds Max and the result of simulation of the von mises stress,

displacement and equivalent strain on the components of the rim, handle and shaft were analyzed.

## ABSTRAK

Model troli pertama telah berkembang sejak abad kelapan belas. Namun, produk ini terus berkembang dengan pesat pada pertengahan abad kedua puluh. Pada pertengahan abad kedua puluh ini, terdapat pelbagai model telah dicipta. Berikutan itu, projek ini mengambil pendekatan maju setapak lagi dalam mereka bentuk troli ini. Objektif projek ini adalah untuk mengembangkan mekanisma pengangkutan muatan berat ke tangga. Keperluan pengangkutan seperti ini diperlukan dalam kalangan masyarakat kita. Troli tangan digunakan untuk mengurangkan tekanan mengangkat semasa berada di tanah rata. Tetapi, kadang kala troli tangan ini gagal untuk mengangkat muatan apabila berhadapan dengan tempat yang bertangga. Sehubungan dengan itu, projek ini dilaksanakan untuk membina sebuah troli yang digunakan untuk membawa muatan berat ketika menaiki tangga dapat meringankan beban berbanding membawa muatan itu secara manual tanpa sebarang alat bantuan. Projek ini juga bertujuan untuk mengkaji daya maju komersial troli tersebut dan kepentingannya. Terdapat beberapa reka bentuk yang digunakan dalam bidang bukan perindustrian untuk melalui tangga, jalan, atau kawasan yang tidak rata sambil mengurangkan tekanan pada pengguna. Dalam projek kami, troli pendakian tangga secara manual dilengkapi dengan roda asas daripada getah yang membolehkannya membawa muatan ketika naik dan turun tangga. Roda trek daripada getah telah diubahsuai untuk memudahkan penggunaan ketika dipasang dan digunakan. Reka bentuknya merangkumi proses seperti percambahan fikiran, membuat lakaran konsep, membuat

pemodelan CAD. Perkara ini juga memudahkan pergerakan troli di permukaan yang tidak sekata seperti tempat yang terdapat lubang, bonggol dan lain-lain. Kesimpulannya, projek ini telah melibatkan lakaran troli secara manual dengan menggunakan Autodesk 3ds Max, simulasi von tekanan, anjakan yang dihasilkan dan ketegangan yang setara pada komponen pelek, pemegang dan batang.



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## LIST OF ABBREVIATIONS

<b>CAD</b>	Computer Aided Design
<b>3D</b>	3 Dimensional
<b>DC</b>	Direct Current
<b>BS</b>	British Standard
<b>ANSI</b>	American National Standards National
<b>HOQ</b>	House of Quality
<b>QFD</b>	Quality Function Deployment

## LIST OF SYMBOLS

<b>m</b>	Meter
<b>kg</b>	Kilogram
<b>%</b>	Percentage

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# CHAPTER 1

## INTRODUCTION

### 1.1 Background

First trolley model evolved long back in eighteenth century, however fast improvement in this field initiated since middle of twentieth century. The main shopping trolley was created by Sylvan Goldman in 1937. Sylvan Goldman claimed a general store chain in Oklahoma, and Sylvan Goldman saw that the clients attempting to convey their goods in over filled, overwhelming hand baskets. With the assistance of a mechanic, Fred Young, made the principal shopping trolley model from a lawn seat, wheels, and a couple of wire baskets. The shopping trolley was not immediately effective. The men viewed pushing a trolley as womanly, while woman thought it unstylish and reminiscent of pushing an infant's surrey. In any case, they in the long run got on the grounds that they made shopping so significantly simpler, and by 1940 their prevalence had developed such a great amount of that there was a multiyear waiting list for different stores to purchase them.

In 1947, Goldman enhanced the Shopping Trolley configuration by supplanting the collapsing part with a settled design, so trolleys could be pushed into one another as it is today. Goldman likewise expanded the size of the trolleys, as understood that a bigger trolley prompts bigger purchases.

The aim of this project is developing a mechanism for easy transportation of heavy loads over stairs. As an understudy, Autodesk 3ds max software was used to design the

product. A trolley is a device utilized by debilitated people to upgrade their personal versatility. There are numerous kinds of trolley accessible within the market like manual or auto trolley and the decision of trolley relies on the physical and mental ability of the client. The hand trolley could be a small transport device that utilized to move heavy loads starting with one place to another place. It perhaps an exceptionally basic tools utilized by a large number of industries that transport physical items. The trolleys can secure individuals from back wounds and other medical issues that can come about because of lifting heavy loads (Alaspure *et al.*, 2016). The new concept is manually stair climbing trolley is designed to reduce burden (Raj *et al.*, 2016). Regular trolley function admirably on flat ground, yet its convenience diminishes when it becomes necessary to move an object over an unpredictable surface. The whole reason for utilizing a traditional trolley manually is to abstain from lifting and carry heavy objects around.

Lifting a trolley up the stairs direct the reason of the device, since the user give enough upward force to lift the whole weight of the trolley and its substance. Besides that, the geometry of a trolley makes it almost difficult to lift with one's legs, just like the correct shape. Extensive strain is set on the back muscles and the danger of operator injury is strongly expanded. The vibration motion may harm the things stacked on the trolley. A trolley that could climb stairs without requiring the client to lift would enhance the safety of moving heavy items over sporadic surfaces.

In this project, a task was given to design a manually-operated trolley with tracks instead of wheels with the end goal to allow the trolley to climb up or down the stairs.

## 1.2 Problem Statement

Based on the market, we have both auto and manual stair climbing trolley. However, for the manual stair climbing trolley, it is using tri-wheel instead of rubber track chain wheel. Stair climber tri-wheel can sometimes be problematic when trying to move on the stair, as the wheel in a rotation position will be in contact with the stair and produce vibration (Gondole, Thakre and Moon, 2016).

In this research, the purpose is to study and design the manually stair climbing trolley. The reason of choosing the manually stair climbing trolley is because of the cheaper cost compare to the automatic trolley. As a beginning, the student will refer to the existing types of trolley that has been design and look for the optimization and redesign opportunities on the way to have better quality of the body structure design. The manually stair climbing trolley can be made from different types of materials – such as tube steel, aluminium tube and high impact plastics. Most commercial trolley that are used for service deliveries are very light weight. The mechanism of the pressing hand paddle can completely eliminate the automatic ship of carrying objects upstairs. It is light weight means that it can be easily transported. It should be easy to move around and to lift too. It also has the ability to reduce or even eliminate the health problems that can arise by using conventional had trolley that still require a lot of manual labour.

A lot of people who live at the apartment are facing difficulty in lifting heavy loads to their house especially to people who live at the higher floors with no lift facility provided. In order to overcome this problem, a new invention of a trolley complete with many useful mechanisms such as stair climbing mechanism can be invented.

### **1.3 Objectives**

The objectives of this project are as follows:

1. To design and select the final design of for manually stair climbing trolley.
2. To find the value of von mises stress, resultant displacement, and equivalent strain through simulation.

### **1.4 Scope of Project**

The scopes of this project are:

1. Low cost product base on manually concept system.
2. The performance parameters consider are of von mises stress, resultant displacement, and equivalent strain.