



**IMPROVEMENT ON CURRENT WHEELBARROW
(WHEELBARROW-ONTHE-GO)**



NUR FARAH FARIZAH BINTI AHMAD

B091910173

**BACHELOR OF MECHANICAL ENGINEERING TECHNOLOGY
WITH HONOURS**

2023



**Faculty of Mechanical and Manufacturing Engineering
Technology**



**IMPROVEMENT ON CURRENT WHEELBARROW
(WHEELBARROW-ON-THE-GO)**

Nur Farah Farizah Binti Ahmad

Bachelor of Mechanical Engineering Technology with Honours

2023

**IMPROVEMENT ON CURRENT WHEELBARROW
(WHELLBAROW-ON THEGO)**

NUR FARAH FARIZAH BINTI AHMAD

**A thesis submitted in fulfillment of the requirements for the degree of Bachelor of
Mechanical Engineering Technology with Honours**



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2023

DECLARATION

I declare that this Choose an item. entitled “Improvement on Current Wheelbarrow (Wheelbarrow-OnThe-Go)” is the result of my own research except as cited in the references. The Choose an item. has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature

:



Name

:

NUR FARAH FARIZAH BINTI AHMAD

Date

:

10/01/2023

اونيورسيتي تيكنيكل مليسيا ملاك

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

APPROVAL

I hereby declare that I have checked this thesis and, in my opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor of Mechanical Engineering Technology (with Honours)

Signature

:

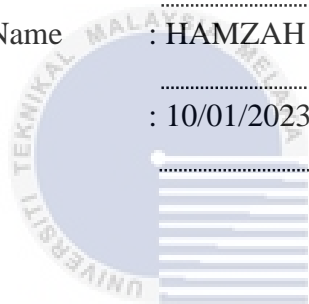


Supervisor Name

: HAMZAH BIN MOHD DOM

Date

: 10/01/2023



اونيورسيتي تيكنيكل مليسيا ملاك

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEDICATION

This work is dedicated to my family and supervisor for great support when things were so tough for constantly kept on encouraging me to work hard, my college friend for moral support and encouragement through my studies and lastly helps for creating an enabling environment to carry out this project



ABSTRACT

A wheelbarrow is a carrier, having only one wheel and consists of a tray bolted to tow handles and two legs. Use as device for carrying small loads for a household gardener, a wheelbarrow also used in construction and industry for carrying larger loads (Kallie, 2019) Wheelbarrows are human-powered carts with one wheel to assist in carrying all kinds of burdens, from harvested crops to mine tailings, and pottery to building materials. Problem occurs during wheelbarrow pushing may have a high risk of overexertion (Datta, 2001) User have to apply 57% and 23% more force in the vertical and horizontal direction while pushing one-wheeled wheelbarrow. Muscular activity increased significantly in the dominant hand with the one wheeled wheelbarrow. (Godilano, K, & A., 2018). The design is composed of two hydraulic dumper real type absorber at back of container, two non-pneumatic wheels in front. With the help of the two additional wheels, the stability problem of the conventional wheelbarrow was resolved. In designing a product, ergonomic aspects such as working posture, energy consumption, conditions of environment, safety and usability need to be considered. These features emphasized in the design of this wheelbarrow-on the-go. A few improvements will be made on the design of wheelbarrow. Among new design innovations will be done are: front lift system to allow the bucket dump independently from the rest of the wheelbarrow, hydraulic dumping real gas absorber with two tires for more stability. Wheelbarrow-onthe-Go comes with improvement in terms of number of tires, simple design of wheelbarrow and pneumatic dumping system compared to an existing product in market. It more convenient to be used by workers which is 20% time saving for works can be transfer and done compared to manual wheelbarrow and manpower. Wheelbarrow-onthe-Go can lift load maximum up to 50 kg.

ABSTRAK

Kereta sorong ialah pembawa, hanya mempunyai satu roda dan terdiri daripada cubaan yang diikat untuk menunda pemegang dan dua kaki. Digunakan sebagai alat untuk membawa beban kecil untuk tukang kebun rumah, kereta sorong juga digunakan dalam pembinaan dan industri untuk membawa beban yang lebih besar. Kereta sorong ialah pengangkutan untuk membantu dalam membawa semua jenis beban, daripada tanaman yang dituai serta bahan binaan. Masalah yang berlaku semasa menolak kereta sorong mungkin mempunyai risiko yang tinggi untuk melakukan kerja berlebihan. Pengguna perlu menggunakan 57% dan 23% lebih daya dalam arah menegak dan mendatar semasa menolak kereta sorong satu roda. Aktiviti otot meningkat dengan ketara di tangan dominan dengan kereta sorong satu roda. Reka bentuk ini terdiri daripada dua penyerap jenis sebenar dumper hidraulik di belakang bekas, dua roda bukan pneumatik di hadapan. Dengan bantuan dua roda tambahan, masalah kereta sorong konvensional akan dapat diselesaikan. Dalam mereka bentuk sesuatu produk, aspek ergonomik seperti postur bekerja, penggunaan tenaga, keadaan persekitaran, keselamatan dan kebolegunaan perlu diamil kira. Ciri-ciri ini ditekankan dalam reka bentuk kereta sorong ini semasa dalam perjalanan. Beberapa penambahbaikan perlu dibuat pada reka bentuk kereta sorong. Antara inovasi reka bentuk baharu yang akan dilakukan termasuklah sistem lif hadapan untuk membolehkan bekas dibuang secara bebas daripada rangka kereta sorong, lambakan hidraulik penyerap gas sebenar dengan dua tayar untuk kestabilan. Wheelbarrow-on-the-go hadir dengan peningkatan dari segi bilangan tayar, reka bentuk kereta sorong yang ringkas serta sistem pembuangan berbanding produk sedia ada di pasaran. Ia lebih mudah digunakan oleh pekerja iaitu 20% penjimatan masa untuk kerja pemindahan dilakukan berbanding kereta sorong sedia ada. Kereta sorong ini mampu mengangkat beban sehingga 50kg.

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

ACKNOWLEDGEMENTS

In the Name of Allah, the Most Gracious, the Most Merciful

First and foremost, I would like to thank and praise Allah the Almighty, my Creator, my Sustainer, for everything I received since the beginning of my life. I would like to take this opportunity to express the sincere appreciation to everyone to who were involved either directly and indirectly and have aided to the through the difficult and crucial times. I would like to extend my appreciation to the Universiti Teknikal Malaysia Melaka (UTeM) for providing the research platform.

My utmost appreciation goes to my main supervisor, Encik Hamzah Bin Mohd Dom from Faculty of Mechanical and Manufacturing Engineering Technology for inestimable and guidance to complete this project in many ways such as refining project ideas, giving implementation and many mores. Both of my parents, Ahmad Othman and Maznah Abdullah for the supported. Our thanks also go to all fellow friend for their patience, cooperation, and assistance provided in completing this report. Their ideas, suggestion, advises, and guidance really help to improve and realize the objective of this report and career in future. Finally, to family members who plays the ultimate roles to continues support and encourage during completing this project.

TABLE OF CONTENTS

	PAGE
DECLARATION APPROVAL DEDICATION ABSTRACT	
i ABSTRAK	
ii ACKNOWLEDGEMENTS	
iii TABLE OF CONTENTS	
iv LIST OF TABLES	
vi LIST OF FIGURES	
vii LIST OF APPENDICES	
CHAPTER 1 INTRODUCTION	1
1.1 Background	1
1.2 Problem Statement	2
1.3 Research Objective	3
1.4 Scope of Research	4
CHAPTER 2 LITERATURE REVIEW	5
2.1 Introduction	5
2.2 Wheelbarrow Placement Innovation	8
2.3 Modern Variation of Wheelbarrow	11
2.3.1 Manual Wheelbarrow	11
2.3.3 Hand Truck	13
2.4 Component of Wheelbarrow	14
2.4.1 The Level	14
2.4.2 The Wheel and Axle	14
2.4.3 Pneumatic	15
2.4.4 Semi-Pneumatic	16
2.4.5 Non-Pneumatic	16
2.4.6 The Tray	17
2.4.7 The Handle	18
2.5 Wheelbarrow System	23
2.5.1 Dumping System (Hydraulic Cylinder absorber)	23
2.5.2 Front Lift & Stop System	25
2.5.3 Non-Pneumatic Tires	25

2.6	Ergonomic of Project Analysis	26
2.7	Summary or Research Gap	28
CHAPTER 3 METHODOLOGY		29
3.1	Introduction	29
3.2	Flow chart Project	30
3.3	Literature Review of Wheelbarrow Application	31
	3.3.1 Ideation Project	31
	3.3.2 Material Selection	32
3.4	Idea and Designing Wheelbarrow-onthe-go	34
	3.4.1 Method use to identify customer needs	34
	3.4.2 Customer Survey	36
	3.4.3 Survey Analysis	36
	3.4.4 Customer Requirement	37
	3.4.5 Target Customer	38
	3.4.6 Morphological Chart	40
	3.4.7 Design Concept and Ideation	41
	3.4.8 Selection Criteria	46
	3.4.9 Final Design Concept	49
	3.4.10 Bill of Materials	52
3.5	Final Project	53
3.6	Summary	54
CHAPTER 4 RESULTS AND DISCUSSION		55
4.1	Introduction	55
4.2	Results and Analysis of wheelbarrow-on the-go	55
	4.2.1 Differences between the current and Wheelbarrow-on the-Go	55
	4.2.2 Results	57
	4.2.3 Analysis Wheelbarrow-on the-Go Functionality	58
4.3	Summary	64
CHAPTER 5 CONCLUSION AND RECOMMENDATIONS		65
5.1	Conclusion	65
5.2	Recommendations	66
5.3	Conclusion	67
REFERENCES		68
APPENDICES		70

LIST OF TABLES

TABLE	TITLE	PAGE
Table 1:	Description of each criteria component used in wheelbarrow	19
Table 2:	Component used for project	32
Table 3:	Customer Importance, Planned Satisfaction and Relative Weight	36
Table 4:	Morphological chart for each problem and option	40
Table 5:	Concept Screening	46
Table 6:	Weighted Rating Methods	47
Table 7:	List of bill materials	52
Table 8:	Differences between current and innovation wheelbarrow	56
Table 9:	Comparison of time taken to transfer 20 bricks to 50-meter distance	58
Table 10:	Result on different type of surface	63

LIST OF FIGURES

FIGURE	TITLE	PAGE
Figure 1	Chinese Wheelbarrow (Szczepanski, 2019)	6
Figure 2	Wheelbarrow used for construction (Szczepanski, 2019)	8
Figure 3	Concept of second class-level of wheelbarrow (Md Shakibul Haque, 2015)	10
Figure 4	Concept of inclined Plane (Md Shakibul Haque, 2015)	10
Figure 5:	Manual Wheelbarrow design (KEMI, 2020)	12
Figure 6:	Motorized Wheelbarrow (Noe, 2018)	12
Figure 7:	Hand Truck (Noe, 2018)	13
Figure 8:	Pneumatic Tyre (Micheal, 2022)	15
Figure 9:	Semi-pneumatic tyre (Micheal, 2022)	16
Figure 10:	Non-Pneumatic tyre	17
Figure 11:	Tray of Wheelbarrow (CORMIDI, 2021)	17
Figure 12:	Rubber handle of tray (KEMI, 2020)	18
Figure 13:	Hydraulic dumper (King, 2020)	24
Figure 14:	Example type of front lift wheelbarrow (KEMI, 2020)	25
Figure 15:	Example of non-pneumatic tyre in market (Micheal, 2022)	26
Figure 16:	Posture of users carry current wheelbarrow (Mazlee, 2021)	27
Figure 17:	Design Concept 1	41
Figure 18:	Design Concept 2	42
Figure 19:	Design Concept 3	43
Figure 20:	Design Concept 4	44
Figure 21:	Design Concept 5	45

Figure 22: Final Design Concept 3	49
Figure 23: Final Design by Solid Work	50
Figure 24: Isometric view of wheelbarrow -onthe-go	51
Figure 25: Von misses stress data	60
Figure 26: Displacement result	61
Figure 27: Strain result	62



LIST OF APPENDICES

APPENDIX	TITLE	PAGE
APPENDIX A	List of Survey Question	70



CHAPTER 1

INTRODUCTION

1.1 Background

The realm of automation, as well as the technologies and types of mechanisms that can be combined into a wheelbarrow, has progressed over time. It's no longer possible to imagine a traditional wheelbarrow as a simple container on wheels that can be moved around; especially on construction sites with complex and high demands if we want to get work done right in a comfortable manner and in a timely manner. (CORMIDI, 2021)

A wheelbarrow is a carrier, having only one wheel and consists of a tray bolted to tow handles and two legs. Use as device for carrying small loads for a household gardener, a wheelbarrow also used in construction and industry for carrying larger loads (Kallie, 2019) Wheelbarrows are human-powered carts with one wheel to assist in carrying all kinds of burdens, from harvested crops to mine tailings, and pottery to building materials. Sickly, wounded, or elderly people could be carried to the advent of the ambulance (Kallie, 2019)

The conventional wheelbarrow usually took a long time to move the load from one place to another place. Nowadays, wheelbarrow in the market have a lot of innovation in term of design and function.

In conclusion, a machine's quality provides for better working outcomes, as the target of this project is to improve the current design of a wheelbarrow, which meets criteria for workers. The differentiating of ergonomics assessment is performed by comparing the existing design of wheelbarrow. Conceptual design was developed based on the problems that have been reported by workers.

1.2 Problem Statement

This project goes through effects of load, one and two wheeled wheelbarrows on muscular activities, hand force, and subject-perceived exertions while pushing a wheelbarrow in a straight line on a horizontal surface. Wheelbarrow being numerous health concern as much of the weight and strain of the load can be put on the users. Problem occurs during wheelbarrow pushing may have a high risk of overexertion (Datta, 2001) User have to apply 57% and 23% more force in the vertical and horizontal direction while pushing one-wheeled wheelbarrow. Muscular activity increased significantly in the dominant hand with the one wheeled wheelbarrow. (Godilano, K, & A., 2018)

Additionally, huge number of labor/workers in many tasks including construction and farming undergo low back musculoskeletal injury due the design of the wheelbarrow which ergonomic needy (Lin, 2020)

The conventional wheelbarrow isn't very stable, and it carries a hefty weight at a high altitude and is prone to tipping over. Due to the fact that it only has one tyre, which makes it unsteady and creates back stiffness, particularly when filled with a slushy, heavy weight like concrete. Wheelbarrow lacks stability which is a major problem. Worker typically employs physical handling to transfer, assemble, and transport work materials from one location to another by lifting, holding, carrying, pushing, and pulling. The existing system of wheelbarrow could make it extremely challenging for users to accomplish jobs that require them to bend forward or draw a weight backwards, causing back discomfort.

The problems above can be simplified as:

1. While using a conventional wheelbarrow, the user must pay close attention to ensure that the load is appropriately transmitted from the bucket to the ground.
2. When duties are repeated or over lengthy periods of time, manual handling can contribute to tiredness and injury.
3. While in use, the conventional wheelbarrow is unbalanced.
4. Loads must be transferred up short steps manually or via other load transfer systems.
5. It's impossible to take a wheelbarrow to a safe and swift halt, especially on an inclined surface.

1.3 Research Objective

1. To design and fabricate a simple and multifunction wheelbarrow by incorporating beneficial features into a standard wheelbarrow.
2. To develop and identify a wheelbarrow that will aid in the dumping of loads by using Hydraulic damper type real gas shock absorber.
3. To analyze data and results from wheelbarrow system.

1.4 Scope of Research

The scope of this research are as follows:

1. This concept employs a hydraulic damper type real gas shock absorber.
2. Maximum loads accommodate is 50kg.
3. It's safe to be used in gardening, agriculture and nursery.



CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Wheelbarrows are one-wheeled carts used by humans to transport a variety of items like ceramics, and construction supplies. Before the ambulance, sick, injured, or old persons may be carried to the doctor. The first wheelbarrows, as well as the first gunpowder, paper, seismoscopes, paper currency, magnetic compasses, crossbows appear to have been invented in China. The first traces of Chinese wheelbarrows can be traced in artworks from the 15th century 100 CE, during the Han dynasty. The operator holding the handles held about half the weight in these wheelbarrows, which had a single wheel at the front of the load. A wall painting in a tomb near Chengdu, in Sichuan Province and dated to 118 CE, shows a man using a wheelbarrow. Another tomb, also in Sichuan Province, includes a depiction of a wheelbarrow in its carved wall reliefs; that example dates to the year 147 CE (Kallie, 2019)

A wheelbarrow is a transport mechanism with just one wheel that comprises of a tray bolted to two handles as well as pairs of legs. While a wheelbarrow is most associated with hauling little loads for the home gardener, it is also frequently employed in construction and industry to transport heavier loads. China, maybe as early as 100 B.C. was the birthplace of the modern wheelbarrow. A massive single axle at or at the platform's front was one among the first variations. Weight put behind the wheel, with the operator lifting and pushing the heavy end. A tiny basket was sometimes used to transport the cargo, and if there was a plenty of it, a second operator may pull from the front. Another design use to have a carrying surface that covered the upper half of the wheel and was practically a big wheel case, it could have been created by Chuko Liang about 300 A.D.

A flat platform jutting in from both sides at axle level could carry huge amounts, people, and merchandise in pannier manner while the operator navigated. Loads was transported in wheelbarrows that were higher off the ground unlike modern wheelbarrows. As a result, Chinese wheelbarrows were comparable to rickshaws in that they had been designed to transport big loads over lengthy ranges. Tseng Min-Hsung in 1200 A.D boasted that ‘ways which are as winding as the bowels of a sheep will not defeat it’.

The Chinese wheelbarrow was designed differently than its European equivalent, as it was powered by human labour, animals of burden, and solar and wind. When compared to a European wheelbarrow, a large axle in the centre of the wagon instead of a smaller wheel in front may easily handle three to six times the weight. Around the time that the enormous Ancient Chinese Road infrastructure began to collapse, the one-wheeled vehicle developed. Rather than clinging to carriages, wagons, and big roadways, the Chinese emphasized on a network of small lanes meant for wheelbarrows, which was considerably easier to maintain. Faced with comparable challenges at the period, the Europeans can't adapt, and as a result, they lost the possibility of smooth road transport for nearly a thousand years.



Figure 1 Chinese Wheelbarrow (Szczepanski, 2019)

European wheelbarrows, unlike Chinese wheelbarrows, were made to transport small loads over short distances. The wheelbarrow's journey from China to Europe is difficult to

trace. It's believed that it was taken to the Middle East by Arab traders, where Europeans found it during the Crusades. The ancient Greeks may have used the wheelbarrow for construction, while the Romans may have adapted it for agriculture. Wheelbarrow could have stayed in use in Byzantium after Rome fell until the Crusaders discovered it on their voyages. However, it is most likely that it was a separate late-medieval invention, constructed by adding a wheel to a two-person hand barrow that was already in use for hauling stones or corn sheaves.

Wheelbarrow most likely first used in agriculture in Europe, and subsequently it moved to construction, commodities transportation, mining, and brick manufacturing. A wooden, box-like body with feet was used on some wheelbarrows. Others had a wicker or slatted framework with feet. In French, Flemish, and Dutch wheelbarrows, the cargo or basket was frequently stabilized by a rail. Wheelbarrows in Switzerland had sturdy wheels, whereas those in England spoked wheels and four feet. Bohemians also used spoked wheels at the time, but no feet have been used to help ease the strain. Leather straps looped around the handles of European wheelbarrows approximately 1200 A.D. to aid in the movement of cargo.

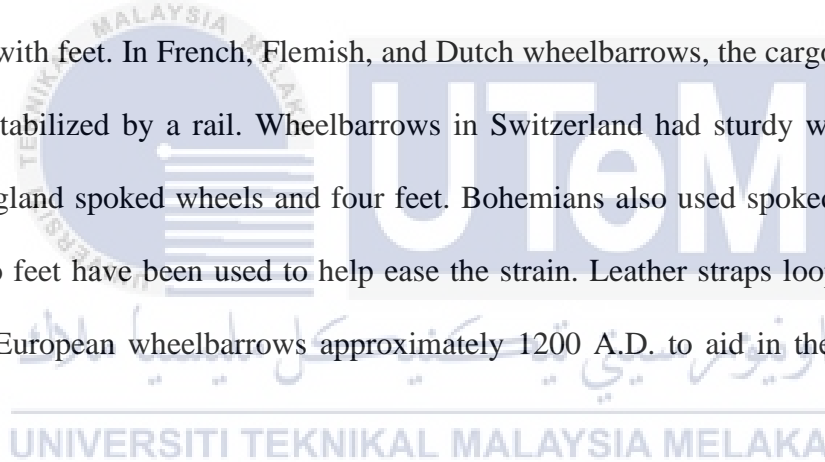




Figure 2 Wheelbarrow used for construction (Szczepanski, 2019)

2.2 Wheelbarrow Placement Innovation

According to Chinese researcher Chen Shou's "Records of the Three Kingdoms," the prime minister of the Shu Han Dynasty during the Three Kingdoms Period—a guy named Zhuge Liang—invented a new type of wheelbarrow as a form of military technology in 231 CE. Shu Han was at the time engaged in a conflict with Cao Wei, one of the three kingdoms called after the era. Zhuge Liang required a quick and efficient way for a single person to convey massive amounts of food and ammunition to the front lines, so he devised a "wooden ox" with a single wheel. The "gliding horse" is another classic moniker for this modest handcart (Bellis, 2020) Using the wooden crate, a single officer could easily carry enough food to serve four soldiers for a month—or the four men themselves. As a result, the Shu Han attempted to keep the technology hidden in order to maintain their advantage over the Cao Wei.

A British inventor James Dyson invented the Ball barrow in the 1970's. A spherical ball substituted the axle at a front end of an injection-molded plastic wheelbarrow (Bellis,

2020). Due to the huge surface area of the ball, which reduces the pressure exerted towards the ground, this wheelbarrow is easier to use on soft soil and also more technically sturdy with heavy things on uneven ground than a traditional design.

When any form of bodily activity calls for a considerable expenditure of effort, the necessary movement must be organized such that muscle power is used most effectively and skillfully. If several muscles join forces, exertion is usually at the greatest when as many muscles as possible contract simultaneously. The maximum force of which a muscle, or group of muscles, is capable depends upon, age, sex, constitution, state of training, momentary motivation. Muscles power peaks, for both men and women, a between 25 and 35 years of age. Older workers, between 50 and 60 years of age, can produce about 75 to 85 percent as much muscular power as during those peak years. (Md Shakibul Haque, 2015)

Second-level have the load between the effort and the fulcrum. A wheelbarrow is a second-class lever. The wheel is the fulcrum, the handles take the effort, and the load placed between the wheel and the effort of the person doing the lifting. The effort always travels a greater distance and is less than the load. When an axle are simple machines that reduces the friction that is acted on a moving object, making the object easier to transport, which in this case can refer to the wheelbarrow. The tire of the wheelbarrow is the wheel and the rod through the centre of the tire is the axle. (Ashwini, 2022)

Like all other simple machines, the wheel and the axle system changes the force by changing the distance over which the force is applied. If the input is reduced to $1/5$ the output force, the force that is applied to the wheel five times its distance. This term is known as mechanical advantage. Mechanical advantage allows humans to perform tasks that would require more force than a person could produce easily, but in conservation of energy.