

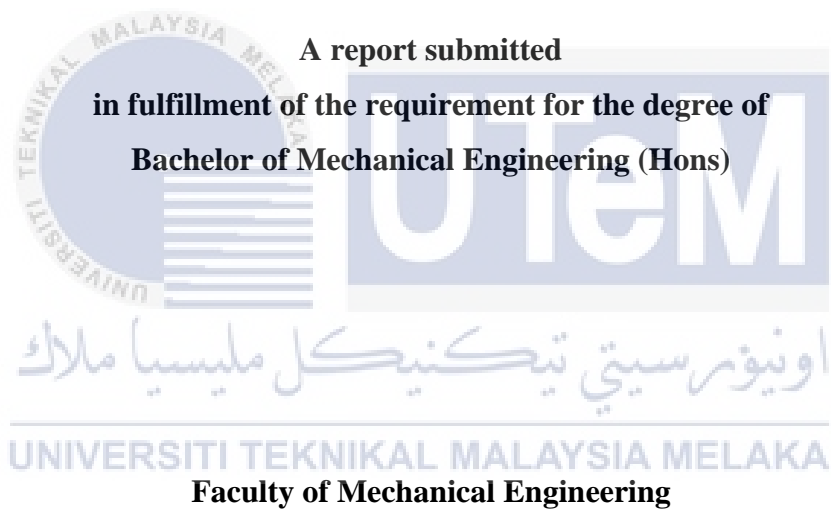
**IMPROVEMENT OF CONE LAYING AND PICKING MACHINE:
THE C2L RAMP USING TRIZ METHOD**



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**IMPROVEMENT OF CONE LAYING AND PICKING MACHINE:
THE C2L RAMP USING TRIZ METHOD**

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2021

DECLARATION

I declare that this project report entitled “Improvement of Cone Laying and picking Machine: The C2L Ramp using TRIZ Method” is the result of my own work as cited in the references.

Signature :

Name : IFFAH HANNANI BINTI SAFARIN

Date : 20 JULY 2021



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APPROVAL

I hereby declare that I have read this project report and in my opinion this report is sufficient in terms of the scope and quality for the award of the degree of Bachelor of Mechanical Engineering (Hons).

Signature :

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Date : 20 JULY 2021



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DEDICATION

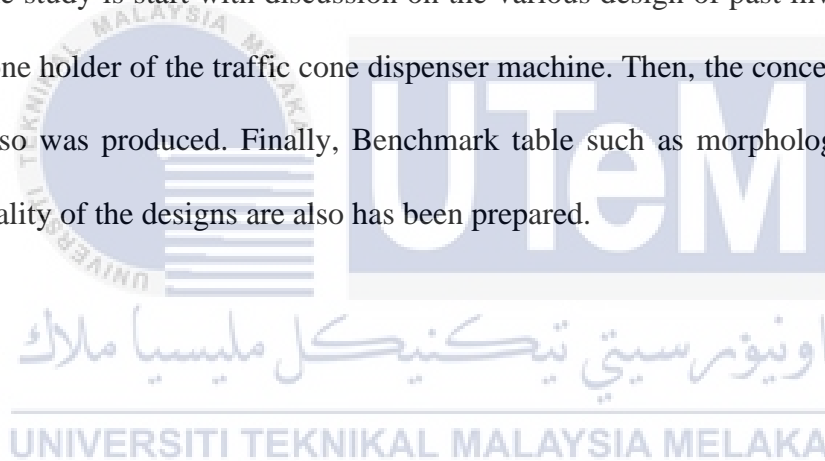
In the name of God, Most Gracious, Most Merciful

To my beloved mother and father



ABSTRACT

The main objective of this project is to make improvement on a traffic cone pick up and laying machine named C2L. This C2L machine is a project collaboration between Universiti Teknikal Malaysia Melaka (UTeM) and PLUS Malaysia Berhad Sdn Bhd. The purpose of this improvement to the C2L machine is to ease the operation of the road worker who will handle this machine and to decrease the time consuming of the work. This project focuses on the design of a new ramp for the C2L machine where previous invention of C2L ramp have two separates of ramp, one is the small size of ramp while another is the big size of ramp. The study is start with discussion on the various design of past invention of cone lifter and cone holder of the traffic cone dispenser machine. Then, the conceptual design of the ramp also was produced. Finally, Benchmark table such as morphological chart and house of quality of the designs are also has been prepared.



ABSTRAK

Objektif utama projek ini adalah untuk membuat penambahbaikan pada mesin pengangkut dan peletakan kerucut lalu lintas bernama C2L. Mesin C2L ini adalah kerjasama projek antara Universiti Teknikal Malaysia Melaka (UTeM) dan PLUS Malaysia Berhad Sdn Bhd. Tujuan penambahbaikan mesin C2L ini adalah untuk memudahkan operasi pekerja jalan raya yang akan mengendalikan mesin ini dan mengurangkan masa memakan kerja. Projek ini memfokuskan pada reka bentuk tanjakan baru untuk mesin C2L di mana penemuan sebelumnya tanjakan C2L mempunyai dua tanjakan yang terpisah, satu adalah tanjakan bersaiz kecil sementara yang lain adalah tanjakan bersaiz besar. Kajian ini dimulakan dengan perbincangan mengenai pelbagai reka bentuk penemuan masa lalu pengangkut kon dan pemegang kerucut mesin dispenser kerucut lalu lintas. Kemudian, reka bentuk konsep tanjakan juga dihasilkan. Akhirnya, jadual penanda aras seperti carta morfologi dan kualiti reka bentuk juga telah disediakan.

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CHAPTER 1

INTRODUCTION

1.0 Introduction

this chapter explained from the general to detail background of the study and the invention. This chapter also includes problem statement and scope of project.

1.1 Background

Picking and laying a cone is one of the duties of road workers when there are maintenance or construction activities happened. The cone symbolizes a warning to the road users to slow down the speed of their car and be careful. Before this project exists, these activities ongoing manually by the road workers. Commonly, safety cones are placed by an individual who is manually delivering and or placing these cones to a particular place on, for instance, but not limited to, a freeway, a road, a street, an intersection, or the like (Brian Patrick, 2003). The number of road worker's death increases day by day. When the death cases of road workers increase, it will give a bad effect on the reputation of the company. Plus, this task is labor-intensive, slow, and could easily result in chronic back injuries in those individuals who perform such a task routinely (Garcia et al, 2004). This project exists to find new and better ways of picking and laying cones for road maintenance and emergency purposes. In conjunction with that, the collaboration has been made with PLUS Malaysia Berhad Sdn.Bhd regarding this issue by doing research and development to build a machine that helps make work easier and safer

A road cone dispenser or collecting machine is a very important apparatus or machine for a road maintenance company. Instead of saving time and maintain the reputation of the company, the death record of road workers can decrease and worker safety guaranteed. (Alan L. Jordan and Ballyclare, 2005) state that the deployment of a collection of such a large number of cones is a time consuming and physically demanding task. To simplify this process, a cone dispensing or collecting apparatus may be employed.

C2L is a portable cone laying and picking system. It is an innovative and ergonomic product design that can potentially improve the efficiency of road closure operation. This project is a collaboration between Universiti Teknikal Malaysia Melaka (UTeM) and PLUS Malaysia Berhad Sdn Bhd. C2L-002 is the 2nd version for Cone collect and laying (C2L) machine. This new design having a few tweaks and have a slightly different design compared to the 001 version. It can be installed in various sizes of a lorry without the need for modification to the existing vehicle. It possesses the ability to lay cones either in a straight or curve pattern by sliding the machine along the tailgate of the lorry. It is powered by using a 24V lead iron battery or can be directly connected to the power source of the vehicle. No other types of power sources are permitted. The C2L is built with three main systems, which are the testbed, cone lifter machine, and the cone guider post. The test bed is attached at the rear end of the lorry tailgate and becomes the hooking point of the cone machine. The Cone machine is equipped with the mechanism to pick up and lay down the cone. It is the brain of the C2L system. A guiding post is used to realign the position and orientation of the cone before being picked up by the machine



Figure 1: C2L 001



Figure 2: C2L 002

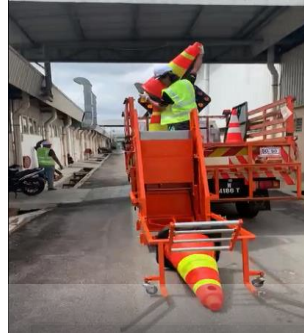


Figure 3: the installation of C2L on the lorry



The C2L important components

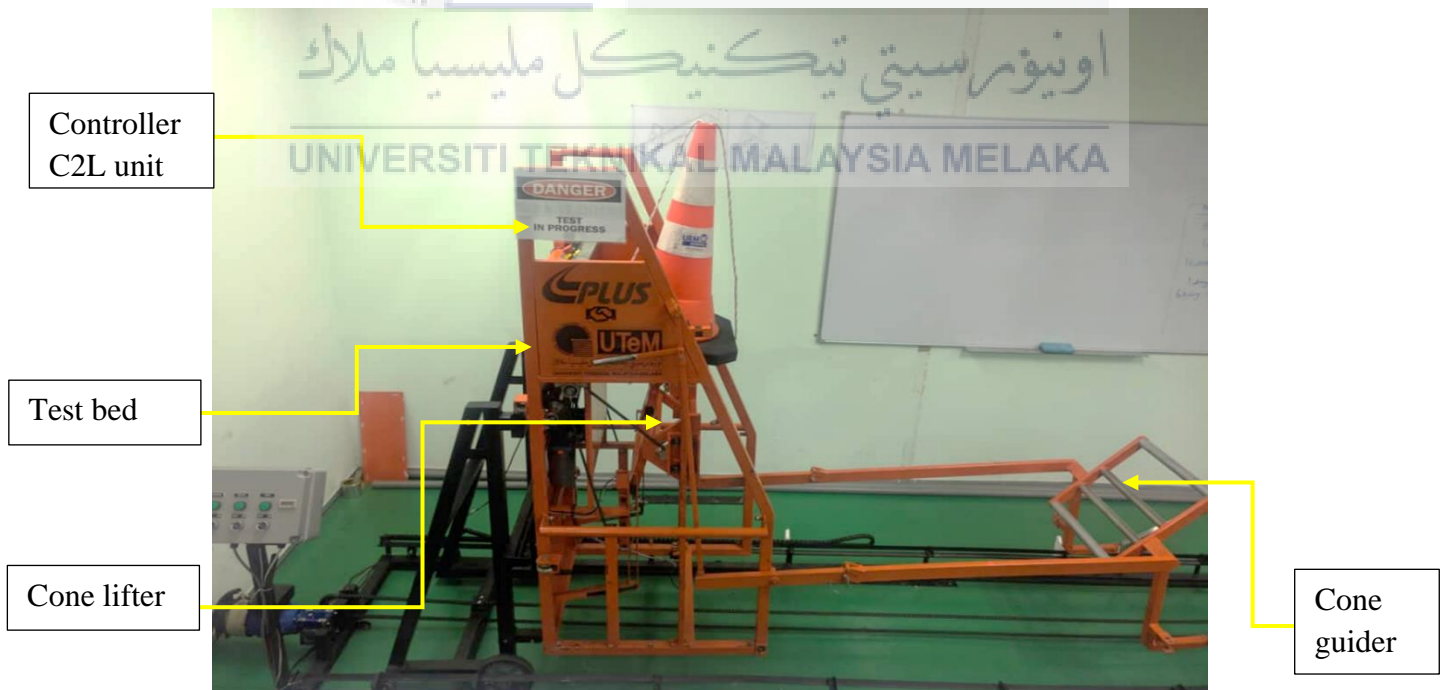


Figure 4: the main components of the C2L machine

a. Controller C2L unit



Figure 5: controller C2L unit

Control the movement of the cone lifter mechanism. When the issue occurred, there is an emergency button to stop the activity.

b. Cone lifter



Figure 6: the cone lifter

This mechanism will pick up and lay down the cone when the activity is start and finish.

c. Cone guider



Figure 7: cone guider post

A guide for traffic cones when the traffic cone was laid. It will realign the position and orientation of the cone before being picked up by the machine

d. Test bed

The test bed is attached at the rear end of the lorry tailgate and becomes the hooking point of the cone machine.

The road cone used



Figure 8: from left is traffic cone rubber base 28 inch and traffic cone rubber base 36 inch

TRIZ method or known as the "Theory of Inventive Problem solving" is an invention philosophy. It is a philosophy in technology, a methodology, and tools. The philosophy of TRIZ is to estimate creative problem resolution and designed product development, create principles that are common for all fields of technology, eliminate contradictions, and use effectively materials, energy, and knowledge for creating the beneficial effects (Ismail E. and Mustafa K., 2015). TRIZ method will be used in this study to solve the problem. The main objective of this present invention of cone lifter is to improve the C2L cone pick and lays the machine and lighten the work of the workers. The design requirements needed is light in weight, simple, shape variable and portable.

The present invention will be design followed some of TRIZ method. Some research of design requirement also was observed in terms of sizes, materials, weights and the shapes. There is not much about shape variable of cone holder neither in automatically or manually.

So instead, the shape of the simple static cone holder was investigated. Adjustable mount, rail and other structure was investigated too. All of this requirement is just a step-by-step idea to create a mechanism for cone lifter holder. The goals of this new invention are to includes the two size of cone holder in one mechanism.

1.3 Problem statement

Cone lifter is a mechanism of picking and laying activity performed or could be say it is the main system of the cone dispenser machine. This mechanism will carry out in the cone dispenser or collecting machine. There are a variety of methods and designs of cone lifter in industries. Some are like receptable holds a plurality of safety cones, chamber that have aperture to delivery and collect the cones and many others. In the latest of C2L project, the previous invention of C2L cone lifter consists of two sizes of ramp and it is portable. One is a small ramp – Ramp A which is about 260 mm x 200 mm x 480 mm (length x width x height) and another one is a big ramp – ramp B which is about 380 mm x 200 mm x 540 mm (length x width x height). The sizes of these cone lifter are followed by the sizes of the traffic cone. These two designs are portable which is they can be taken off and taken on depending on the cone picking and laying activity. The ramp will be attached to the cone lifter mechanism using a pin. So, the issue that occurred here is it is time consuming and lease ease of operation for the road worker as they need to install and reinstall the ramp. The study was prepared to solve this problem in terms of investigating and designing a new design of cone holder that consist two sizes of cone in one mechanism. This design can be performed either in automatically or manually.



Figure 9: cone lifter full assembly



Figure 10: ramp A



Figure 11: ramp B

1.2 Objectives

This research contains several objectives as follows:

- i. To improve the old design of C2L ramp
- ii. To investigate the design requirement using TRIZ method
- iii. To design and draw the new design of C2L ramp using Solidwork software
- iv. To determine the reliability of new design of C2L ramp using finite element analysis

1.4 Scope of project

This project covers the scope of:

- i. Only studies of design requirement using TRIZ method of C2L ramp
- ii. Only design and draw the new design C2L ramp
- iii. Only do analysis of C2L ramp using finite element analysis

1.5 Chapter summary

This chapter discussed about the background of this study, the problem statement, the objective of the project and the scope of the project. C2L machine is a pick up and lay traffic cone machine where this project is a collaboration between Universiti Teknikal Malaysia Melaka (UTeM) and PLUS Malaysia Berhad Sdn Bhd. The reason why this cone dispenser machine exist is because of the deployment and collection of such a large number of traffic cones is a time consuming physically demanding task. Plus, it is to removes the need for workers to be on the road while road cones are being laid or collected as to decrease the death record of workers. the focus topic in this study is the improvement that will be done to the C2L machine which is we will improve the ramp of the cone lifter of the C2L machine.

Every purpose of a project is coming from the issue or problem happens. The problem statement here is the usage previous ramp in terms of saving time is decrease. There will be two different sizes of traffic cone that will be used to pick up and laid by the C2L machine. Testing has been done in terms of the time taken to change the ramp on the road. so, it has been proved that usage of the previous ramp is time consuming and in addition it does not ease the operation of the worker. If the changing ramp activity is conducted by a person in a long period of time will affect back injury of the worker.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

This chapter will explain the literature review of the project in detail. The research focuses on the whole design of cone holder at cone lifter mechanism, the concept of how it works, the compartment inside it and the TRIZ method used. The literature review was done for better views on the relationship between the past studies and present invention.

2.1 Background of previous invention

Cone dispenser is a machine that build to ease the process of dispensing and collecting the road cones. This machine is usually built on a lorry or a truck either in separate or permanently attached on the vehicle. When maintenance, construction or accidents happened, the road cone which is usually brightly coloured and hollow conical shaped is laid one by one with about 5 meters long distance next to each other. The present invention relates generally to road safety. There is no cone dispenser available in Malaysia. Road cone dispenser or in short is a pick up and laying road cone machine which the name of present invention of cone dispenser is C2L machine. The C2L machine is the first road cone dispenser where it is currently a project between UTEM and PLUS Malaysia Berhad Sdn Bhd.

Sliding and conveyer system

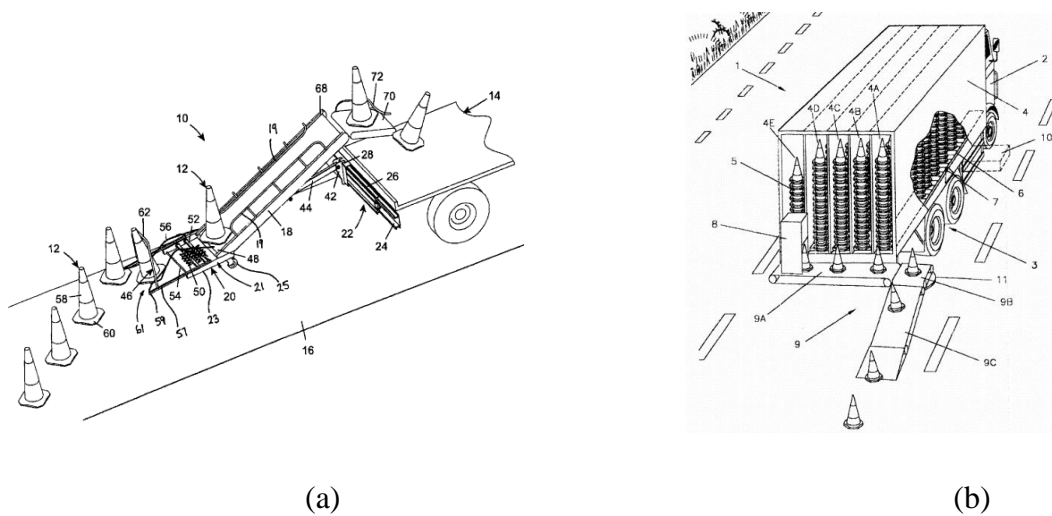


Figure 12: shows (a) traffic cone dispenser by Alan L.J and Ballycare and (b) traffic cone dispenser by Patrick Flynn

This study is only focusing on improvement that will make to the C2L machine which it is to improve the part at the cone lifter of C2L machine. The mechanism job is to pick up and laying the road cone when the activity performed and this mechanism is the main component of C2L machine. There are many types of past invention of cone lifter system such as delivery system either with storage or non-storage like a chamber, using robotic arm to grip the road cone, sliding system and etc. (Alan L. Jordan and Ballycare, 2005) using a sliding system to laid the road cones. The sliding mechanism by means of a carriage is slidable with respect to the sliding section in the transverse direction. The method is simply sliding the traffic cones by the worker at the sliding mechanism and the cone will be slide and fall then move through the cone guider like a rail guide and lastly will tilt to its upright position by the toppling device. The apparatus used for laying and collecting traffic cones by (Patrick Flynn, 2003) also used the same method. The different is in term of design of the conveyer. For Patrick F. the design the sliding method for the apparatus of cone laying and picking. The machine has two conveyers to deliver the traffic cones. One transverse

conveyer that stick at the road vehicle and another one vertical conveyer from road vehicle. A storage chamber also one of the aspects that make it slightly different compared to previous design. Another contrary is the machine is automatically deposited from the chamber to the conveyer

The funnel and drop off system

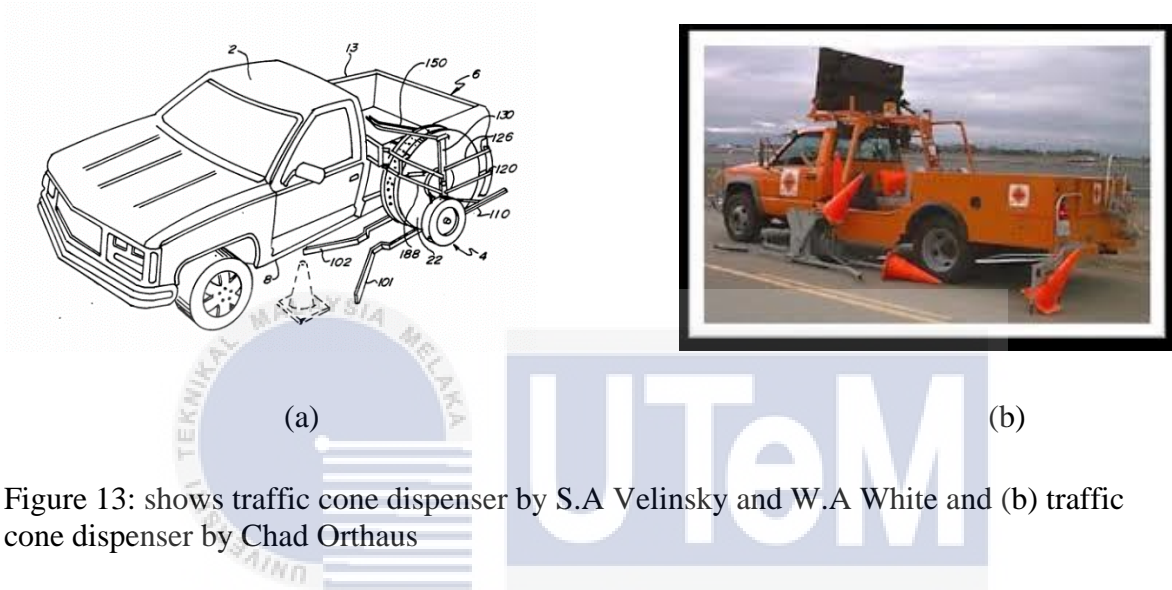


Figure 13: shows traffic cone dispenser by S.A Velinsky and W.A White and (b) traffic cone dispenser by Chad Orthaus

Afterwards, another well-known design of cone dispenser using funnel and retrieved system placed at beside of vehicle road. Most of all, these kinds of design were for small vehicle road like truck. The traffic cones mostly are deposited manually by the road worker but it can be done in automatically too. Their cone retriever mechanism is also different and has their own speciality. According (S.A. Velinsky and W.A.White, 2004), the design were done in automatically using stowage and conveyer system. The gripper mechanism inserts and remove cones, one at a time to and from the stacks then move to the drop box assembly. Then, the traffic cones will be moved to the drop box assembly and drop off from the truck. The position traffic cones thereupon will be adjusted and tilt by the toppling device at the end beside of the truck. Another design of traffic cone retriever also used same method but have slightly contrary. A rotatable cone conveyer moves the cones between upper and lower