UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DESIGN AND FABRICATION OF FLIPPABLE CAR HAZARD TRIANGLE USING CAR FLOOR MAT AS PLATFORM

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

by

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Tajuk: **DESIGN AND FABRICATION OF FLIPPABLE CAR HAZARD TRIANGLE USING CAR FLOOR MAT AS PLATFORM**

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APPROVAL

This report is submitted to the Faculty of Mechanical and Manufacturing Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Mechanical Engineering Technology (Refrigeration and Air Conditioning System) with Honours. The member of the supervisory is as follow:

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ABSTRAK

Apabila populasi manusia semakin meningkat, permintaan kereta akan meningkat di pasaran dan pembuatan kereta di dunia automotif juga turut meningkat dengan selari. Disebabkan itu, apabila jumlah kenderaan penjualan dan di atas jalan raya di Malaysia semakin meningkat, bilangan kemalangan di jalan raya juga turut meningkat. Oleh itu, usaha bagi mengurangkan kadar kemalangan di Malaysia perlu dipertingkatkan. Kertas kerja ini merupakan salah satu usaha kecil bagi mengurangkan kemalangan di jalan raya disebabkan oleh pelanggaran kenderaan yang bergerak dengan kenderaan rosak berhenti di bahu jalan atau di tengah jalan. Pelanggaran ini terjadi kerana pemandu kenderaan yang bergerak tidak melihat dan tidak sempat bertindak untuk mengelak kenderaan yang rosak tersebut. Jadi, penghasilan reka bentuk segitiga kecemasan dapat meningkatkan kadar amaran kepada pengguna jalan raya yang lain terhadap kecemasan yang berada di hadapan mereka supaya mereka lebih berhati-hati dan bersiap sedia dengan mengurangkan kelajuan kenderaan. Bilangan segitiga kecemasan pada masa kini hanya satu di dalam bonet kereta kerana tidak mahu ruang bonet di dalam kereta berkurangan. Apabila kenderaan rosak pada waktu malam, hujan atau kabus boleh mengurangkan penglihatan pemandu kenderaan lain terhadap segitiga kecemasan dan pemandu kereta itu tidak sempat untuk bertindak bagi mengelakkan kenderaan rosak di hadapan mereka. Oleh itu, reka bentuk segitiga kecemasan dalam kertas kerja ini dapat membantu meningkatkan bilangan segitiga tanpa menggangu ruang bonet di dalam kereta dan boleh dipakai untuk diletakkan di jarak yang lebih selamat untuk memberi amaran kepada kenderaan bergerak yang lain.

ABSTRACT

Increasing number of human populations will increase number of vehicles on the road. Because of that, when the number of vehicles in Malaysia increases the number of accidents on the road also will increase. Therefore, it is important to improve the safety of road users to reduce the number of accidents in Malaysia. This project is one of the little efforts that can be done to reduce accidents that may be caused by the breakdown cars that stopped at roadside or middle of the road. Collisions may occur between the breakdown vehicle and the upcoming vehicles that does not alert and see to react and avoid the breakdown vehicle. Therefore, the new design production of hazard triangle can increase warning precaution to other road users to warn them the hazard in front of them and they will have a lot of time to prepare avoiding the obstacles. Nowadays, the number of hazard triangle provided in every car is only one. However, when the car is having a breakdown at night, rain or fog the hazard triangle will be insufficient to warn upcoming drivers that have limited vision towards the only one hazard triangle and the driver will not have enough time to react to avoid the breakdown vehicles in front of them. Therefore, the new design of hazard triangle in this project will help to increase the number of hazard triangle without using any space in the bonnet and can be placed at a very safe distance to warn the upcoming drivers much earlier.

DEDICATION

I would like to dedicate this project especially to my beloved parents and my family with their encouragement to increase my spirit and strength throughout the whole time completing this project. I also would like to dedicate this to all of my friends which always with me that monitor my project development and help me completing this project calmly and reduce my stress. Without them I would not be able to complete this project alone and on time.

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Firstly, I would like to thank god for giving me the chance and strength to do this project and from this project I am able to gain knowledge during completing it. I also would like to my thanks and appreciations towards my strict and beloved supervisor Mr. AZMAN BIN IBRAHIM for his support and teach me on how to do this project step by step. Without him being strict on me by asking my progress every week, giving me advices, encouragements and guidance, I would not be able to complete this project perfectly and on time. I also would like to give my appreciations to my co-supervisor Mr. SHIKH ISMAIL FAIRUS BIN SHIKH ZAKARIA that always help me when things get difficult. Finally, thank you to everyone that involved in this project directly or indirectly for their helps and co-operation. Without their help I would not succeed in completing this project and I would have a lot of difficulties. I enjoyed doing this flippable car hazard triangle using car floor mat as platform project which may help reducing the number of road accidents in Malaysia.

TABLE OF CONTENTS

CHAPTER 5: CONCLUSION

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

1.1 Background of Study

Hazard triangle become a necessity to people who owns a car for safety precaution and avoid secondary accidents. Nowadays, for every car production the automotive industry provides the car with only one hazard triangle because it is compulsory to carry at least one. However, it is not enough to fulfil the safety condition of hazard triangle placement on the road. Moreover, because of insufficient number of hazard triangle provide by automotive industry will have drawback to the user especially at low visibility time which is during raining, fog, night time and on the curve way road. During this time, more hazard triangle is needed to warn upcoming vehicle from far to be prepared of the hazard that they still cannot see. Besides that, the current design of hazard triangle has a lot of weaknesses which is the reflective material of the hazard triangle is not sufficient, too light and can be toppled down by strong wind, and finally the installation is quite difficult and this can take longer time for the user to install it and during that delaying time the approaching vehicle may not realize the hazard and collision will occur.

The warning triangle provide people with warning, danger and caution and in order to alert the upcoming driver, the hazard triangle must be attractive and high visibility to warn people much earlier and let them have enough reaction time. From the article written by (Rose, 2010), she states the quotation from William J. Vigilante

and Michael S. Wogalter in "On the Prioritization of Safety Warnings in Produc1t Manuals," manuals are frequently difficult to read and comprehend because they fail to highlight important information to capture users' attention and therefore from this quotation, safety warning triangle is important to deliver messages quickly and effectively. (Rose, 2010) in her research discovered a problem which is in term of design, safety warning messages are needlessly varied and confusing. The problem is that does the warning's bold type indicate a more serious hazard than the one using a run-on header? Her review is that based on different design theory and techniques the safety warning triangle is designated and produce. Warning triangle design is critical and important to play a crucial role in maintaining the safety of users.

American National Standard Institute (ANSI) have been establishing a few guidelines to aware the designing message. However, the guidelines are one way to design the hazard triangle because of limited to specific types of warning messages for specific settings. The guidelines come with general design principle which include the benefits of using the correct symbols for right situation, colors and optimum size for indicating the environment. Unfortunately, the current information on designing hazard triangle does not allow the design criteria that can be adapted to a broader range of communication settings (Rose, 2010). Hazard triangle not only can be used when the car is having a breakdown but also can be use when there is accident and to help people which currently are having an accident. This is to avoid greater accident caused by the upcoming vehicle with high velocity on the road and avoid the accidents to become more fatal.

Based on research, the number of accidents in Malaysia are increasing linearly with the number of vehicles on the road. Therefore, it is important to increase the safety factor on the road to reduce statistic of accidents in Malaysia. Improving hazard triangle design and increase the quantity can also be one major factor to reduce the accidents. Even though, cars are being maintain properly and people driving slowly and safely that does not mean that no accidents would occur on the road. As an example, there might be landslide on the road or any environment reason that cannot be expected to occur. During this emergency cases, the hazard triangle is still needed to be installed and used by the users.

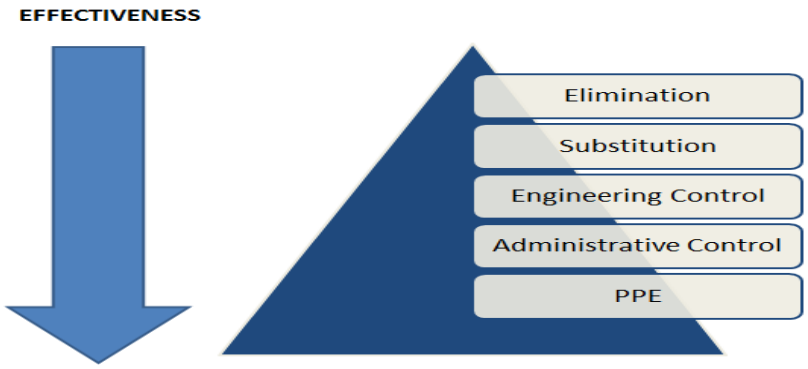

Figure 1.1: Hierarchy of control (Jeffrey Daito, 2015)

According to (Jeffrey Daito, 2015) in order to control the hazard, it is important to follow the hierarchy of controls which is as shown in **Figure 1.1**. The warning triangle is included in PPE which is Personal Protective Equipment. From the figure, we can see that the effectiveness of PPE is the lowest compared to other order of control. However, in the road case accident the other factors cannot be done and PPE may be one of the first things that springs to mind when you're thinking of controlling a hazard, it should never be the first control you turn to. In fact, you should only turn to PPE as a possible control when all other controls have been exhausted and there's still an unacceptable level of hazard.

1.2 Problem Statement

The increasing number of vehicle's accidents on the road is the problems that had been increasing over the years. This occur because of carelessness of the road users that are driving recklessly and are not well-prepared before and during driving. Because of this, number of accidents in Malaysia increasing significantly as shown in **Table 1.2**.

Table 1.2: Accident statistic in Malaysia over entire states (Ministry of Transport Malaysia, 2017).

NEGERI *State*	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
PERLIS	1,364	1,417	1,633	1,548	1,791	1,881	1,895	1,888	1,861	2,062
KEDAH	16,172	16,520	17,701	17,966	19,699	19,935	20,228	20,159	22,016	23,200
PULAU PINANG	33,881	34,049	33,719	34,306	37,158	37,851	39,361	38,747	39,856	42,244
PERAK	29,203	30,539	32,327	32,072	33,506	34,714	35,408	35,131	36,736	38,531
SELANGOR	99,157	100,380	107,429	115,565	128,876	129,106	135,024	137,809	140,957	151,253
W.P. KUALA LUMPUR	49,454	48,671	51,942	53,493	58,795	61,872	64,527	63,535	64,664	68,866
NEGERI SEMBILAN	16,079	17,362	18,369	19,407	21,157	22,146	23,066	23,748	22,939	24,428
MELAKA	11,720	12,105	13,275	14,110	14,720	15,195	16,083	16,375	17,069	18,601
JOHOR	46,584	48,667	51,747	55,381	59,501	62,316	64,600	64,473	67,112	73,116
PAHANG	13,982	15,629	17,068	17,315	19,001	20,554	20,130	19,071	19,635	20,465
KELANTAN	8,116	8,842	9,549	9,707	9,603	9,968	9,748	10,326	9,960	10,544
TERENGGANU	8,155	8,814	10,118	10,106	10,684	10,861	10,996	9,383	10,381	10,793
SABAH	14,256	14,588	15,798	16,192	16,585	17,446	17,438	17,858	17,290	17,298
SARAWAK	15,196	15,488	16,655	17,253	17,964	18,578	18,700	17,693	19,130	20,065
JUMLAH *Total*	**363,319**	**373,071**	**397,330**	**414,421**	**449,040**	**462,423**	**477,204**	**476,196**	**489,606**	**521,466**

The statistics in **Table 1.2** shows the increasing number of accidents in Malaysia for every states from a report by MIROS (Ministry of Transport (MOT), 2017) . Selangor has the highest number of accidents because the number of Selangor's residence is the highest compared to other states. This means that, as the number of road users increases the number of total accidents also will be increase. Therefore, from this statistic actions should be taken to reduce the number of accidents in

Malaysia. Redesigning the hazard triangle could help even though a little in reducing the number of accidents in Malaysia. Especially in this modern era, producing a great design of hazard triangle is not impossible anymore and the hazard triangle needs to follow modernisation era. If smartphone can be produced, materials for safety purposes also should be innovated and improved.

The main problem of the current hazard triangle is the number of hazard triangle inside the car is only one which is insufficient for the hazard triangle placement according to guideline given by Federal Motor Carrier Safety Administration (FMCSA). When the number of hazard triangle insufficient, during bad weather such as rain and fog which the drivers have very limited vision and they couldn't see the hazard triangle or be warned early the idle car and the upcoming car will have very high risk of collision between one and another. The current design of hazard triangle also gives problems to the road users. The hazard triangle is using a poor reflective material and this can make the other road users to react with insufficient time and collision could occur especially in a bad weather that can limit visions of the driver when on the road. Besides that, the previous warning triangle does not have LED on it. LED do help a lot to attract attention from other road user and avoid pensive people ignoring the hazard in front of them.

The warning triangle also are too light weighted and this can make the emergency triangle being toppled by the wind easily and this can increase the risk of upcoming vehicles not detecting the stopped car at the front. Lastly, the problem with the current emergency warning is that the warning triangle are too complicated in installing it. Installation of the hazard triangle does take some time especially for those who never use it and practice using it at home. Firstly, to install it the hazard triangle have to take

out from its box and there is some box very fitted with the hazard triangle and it is hard to pull it out. Next, all the reflective body of the hazard triangle need to be attached to one another and the stand also need to be positioned properly. With this project, all the problems above can be solved by attaching the hazard triangle on a floor mat which solve the hazard triangle toppling over and over again, easy installation, high reflective material and the presence of LED.

1.3 Objective

The main objective that need to be achieved at the end of this project is to: -

- Develop new design of hazard triangle that will be needed by users to increase safety purposes
- Analyse data from tests that have been conducted

1.4 Work Scope

The maximum scope of this project is:

- Hazard triangle for car brand Perodua because it has the highest sales in Malaysia
- Hazard triangle for road users only and not for any other hazard such as industrial hazard.
- Suitable only for 4 seated vehicles.

1.5 Expected Result

As the product is being accomplished, ideas are obtained and learned from other people using the literature review and combine it to perfect the product that will be produced in perspective of the design and material used. Then, from the ideas of design and materials needed the solid work software is used to create and design the product

as wanted. After designation process had been done, fabrication process step in to produce the product referred to the design. Machines that involves with the fabrication of the product helps in producing the expected product. Tests are conducted to observe the materials of the hazard triangle as wanted which is the hazard triangle should be seen from far even in a weather that have limited visions. Another tests that can be done is the spring elastic potential related to the weight of the hazard triangle to allow the upright of hazard triangle without exceeding the elastic potential. As an expected result regarding the material, the hazard triangle produce must be sturdy from any impact and have high reflective material that can be seen from far including with the LED that helps increasing the vision towards the hazard triangle. The spring used also can maintain its elastic potential to support the hazard triangle from falling down.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Rising global accidents are often related to the expanding use of automobiles because people can easily go anywhere they want by using the automobile whether they are going to work place, travelling across the country or sending their children to school. In 1980s, Malaysia's industrial strategy is to build nationally owned and controlled automotive industry because of the Heavy Industrial Policy. Malaysia manufacturing of automobile has been increasing since 1980 to 2009 and the total vehicle sales rise from around 97,000 in 1980 to 2009 while the production of vehicles increased from 104,000 in 1980 to 489,000 in 2009 (Wad & Chandran Govindaraju, 2011). Since production and accidents of cars increases, an emergency kit is a must haves in all car because there is no confirmation that no problem arises on the road no matter how well the car is maintained. When there is well-equipped emergency car kit packed in the trunk, the hazard or breakdown of the car on the side of the road can be more bearable even though no one want to get stranded (Lisa Bedford, 2013). Tom Crosby, AAA of the Carolinas says every year one in three motorists get a roadside breakdown situation and prevent vehicle from moving such as flat tire problem, dead battery or mechanical problems (Russ Heaps, 2010). One of the most important must have in emergency kit is three reflective warning triangles. Crosby suggest to have at least three warning triangles and placed them 50 feet apart to warn upcoming vehicles

much early even though pre-packaged emergency kits contain only one warning triangles for every car (Russ Heaps, 2010).

2.1.1 Automobile Accident Statistics in Malaysia

The number of populations will increase the number of automobile production and sales. As the number of automobiles on the road is increase the number of accidents between road users also will be increase. This can be proved from the statistics shown in **Table 2.1** of the total accidents occur in Malaysia in 1997 to 2016 and the statistics is recorded by official government website of Malaysian Institute of Road Safety Research (MIROS).

Table 2.1: Accident statistic by Malaysian Institute of Road Safety Research (MIROS) (**Source**: https://www.miros.gov.my/1/page.php?id=17)

General Road Accident Data in Malaysia (1997 – 2016)

Year	Registered Vehicles	Population	Road Crashes	Road Deaths	Serious Injury	Slight Injury	Index per 10,000 Vehicles	Index per 100,000 Population	Indeks per billion VKT
1997	8,550,469.00	21,665,600.00	215,632.00	6,302.00	14,105.00	36,167.00	7.37	29.10	33.57
1998	9,141,357.00	22,179,500.00	211,037.00	5,740.00	12,068.00	37,896.00	6.28	25.80	28.75
1999	9,929,951.00	22,711,900.00	223,166.00	5,794.00	10,366.00	36,777.00	5.83	25.50	26.79
2000	10,598,804.00	23,263,600.00	250,429.00	6,035.00	9,790.00	34,375.00	5.69	26.00	26.25
2001	11,302,545.00	23,795,300.00	265,175.00	5,849.00	8,680.00	35,944.00	5.17	25.10	23.93
2002	12,068,144.00	24,526,500.00	279,711.00	5,891.00	8,425.00	35,236.00	4.90	25.30	22.71
2003	12,819,248.00	25,048,300.00	298,653.00	6,286.00	9,040.00	37,415.00	4.90	25.10	22.77
2004	13,828,889.00	25,580,000.00	326,815.00	6,228.00	9,218.00	38,645.00	4.52	24.30	21.10
2005	15,026,660.00	26,130,000.00	328,264.00	6,200.00	9,395.00	31,417.00	4.18	23.70	19.58
2006	15,790,732.00	26,640,000.00	341,252.00	6,287.00	9,253.00	19,885.00	3.98	23.60	18.69
2007	16,813,943.00	27,170,000.00	363,319.00	6,282.00	9,273.00	18,444.00	3.74	23.10	17.60
2008	17,971,907.00	27,730,000.00	373,071.00	6,527.00	8,868.00	16,879.00	3.63	23.50	17.65
2009	19,016,782.00	28,310,000.00	397,330.00	6,745.00	8,849.00	15,823.00	3.55	23.80	17.27
2010	20,188,565.00	28,910,000.00	414,421.00	6,872.00	7,781.00	13,616.00	3.40	23.80	16.21
2011	21,401,269.00	29,000,000.00	449,040.00	6,877.00	6,328.00	12,365.00	3.21	23.70	14.68
2012	22,702,221.00	29,300,000.00	462,423.00	6,917.00	5,868.00	11,654.00	3.05	23.60	13.35
2013	23,819,256.00	29,947,600.00	477,204.00	6,915.00	4,597.00	8,388.00	2.90	23.10	12.19
2014	25,101,192.00	30,300,000.00	476,196.00	6,674.00	4,432.00	8,598.00	2.66	22.00	10.64
2015	26,301,952	31,190,000	489,606	6,706	4,120	7,432	2.55	21.5	9.6
2016	27,613,120	31,660,000[e]	521466[a]	7152[a]	NA	NA	2.59	22.6	NA

Malaysia also is ranked as the top 3 countries after Thailand and South Africa that have the most accidents occur which reported by Bloomberg on 20 June and the statistics is from World Health Organisation (WHO) for 2013 (Tang Ruxyn, 2017). From the data shown in **Figure 2.1**, Malaysia has road death rate which is 23/100,000 population. Based on estimation of 30 million Malaysians population, 7000 to 8000 people die on the road every year and the total death is very high (Tang Ruxyn, 2017).

Figure 2.1: World Health Organization, Renaissance Capital Statistics

(**Source:** http://says.com/my/news/malaysia-s-roads-among-the-world-s-most-dangerous-and-deadliest)

However, Malaysia has taken initiative to make a road safety plan which were implemented during 2006-2010 period in order to reduce road accidents with nine strategies and obtain the targets as shown in **Table 2.2.**