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REAR AND SIDE UNDER CARRIAGE SAFETY BARS FOR MALAYSIA HEAVY VEHICLES

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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 scope and quality for the award of the degree of Bachelor of Mechanical Engineering (Design & Innovation).

Signature :. .....

Name of Supervisor : .....

Date : .....

REAR AND SIDE UNDER CARRIAGE SAFETY BARS FOR MALAYSIA HEAVY VEHICLES

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This report is submitted
in fulfillment of the requirement for the degree of
Bachelor of Mechanical Engineering (Design and Innovation)

Faculty of Mechanical Engineering

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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DECLARATION

I declare that this project report entitled "Rear And Side Under Carriage Safety Bars For Malaysia Heavy Vehicles" is the result of my own work except as cited in the references

Signature : .....

Name : .....

Date : .....

DEDICATION

To my beloved mother and father that always support me whether in hard times or good times. Special thanks to them for always giving me the moral support, advice and also financial assistance in order to complete my studies.

ABSTRACT

Heavy vehicle safety is a serious matter for road transport authorities. Although their numbers make up only a small percentage of motor vehicle registrations. This is not to say heavy vehicles are always at fault but their size and mass makes any crash a serious one. Improvements to heavy vehicle design and safety features have made a meaningful contribution in reducing the number and severity of crashes. Currently there are a wide range of crash avoidance and harm minimizing technologies available on the market that have the potential to improve safety. There exists a large mismatch between the bumper of a passenger vehicle and the ground clearance of heavy vehicles. During collisions between the car and the side of the heavy vehicle, a large amount of intrusion is observed in the passenger compartment due to under ride. The result of these collisions often leads to injuries or fatalities. This research aims to develop side under ride protection devices and rear under ride protection device to eliminate the incompatibility between the small vehicle's bumper and bottom of the trailer or box of the straight truck. To successfully design these guards, a procedure for analysing the effectiveness of the under ride protective device during a side crash was implemented by using the Finite Element Method within Catia V5 package. Based on this thesis, shows that cross section of solid bar is more better than for hollow bar.

ABSTRAK

Keselamatan Kenderaan berat adalah isu yang serius bagi pihak berkuasa pengangkutan jalan walaupun bilangan mereka membentuk hanya peratusan kecil dalam pendaftaran kenderaan bermotor. Ini tidak bermakna kenderaan berat sentiasa bersalah tetapi saiz dan jisim besar dan berat membuatkan sesuatu kemalangan satu yang serius. Penambahbaikan kepada reka bentuk kenderaan dan ciri-ciri keselamatan kenderaan berat telah menyumbang kepada mengurangkan bilangan dan keterukan kemalangan. Pada masa ini terdapat pelbagai teknologi untuk mengelakkan kemalangan dan yang terdapat di pasaran dan mempunyai potensi untuk meningkatkan keselamatan. Wujud jurang ketinggian yang besar di antara bumper kereta dan hujung belakang kenderaan berat. Dari tepi pula, jika berlaku perlanggaran, kereta mungkin terperosok ke bawah treler tanpa ada halangan. Kemalangan sebeginu pula lazimnya mengakibatkan kecederaan parah atau kematian. Justeru. Kajian ini ingin membangunkan peranti penghadang di belakang dan di sisi kenderaan berat. Bagi menguji keberkesanan rekabentuk, analisis dengan kaedah Finite Element digunakan dengan pakej Catia V5. Berdasarkan kajian ini juga, penghadang yang solid menunjukkan lebih tegug berbanding dengan penghadang yang mempunyai lubang di tengah.

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The completion of this undertaking could not have been possible without the participation and assistance of so many people whose names may not all be mentioned in this report. Their contributions are sincerely appreciated and gratefully acknowledged. First of all, I wish to my express my sincere gratitude to Dr. Shamsul Anuar Bin Shamsuddin as my supervisor for providing me an opportunity to do this project. Besides, he also guides me on how to carrying out this project.

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Once again, I thank all those who have encouraged and helped me in preparing this thesis and who have extended me much understanding, patience, and support until the end.

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SUPD	Side Under-run Protection Device
HOQ	House of Quality
FEM	Finite Element Method
CAE	Computer Aided Engineering
CAD	Computer Aided Design

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CHAPTER 1

INTRODUCTION

1.1 Background

The first working self-propelled transport was created by Carl Benz in year of 1885. At that time, Benz was the first person think about designing car using petrol or gasoline powered automobile. World nowadays, starting to follow by improving this idea hence reproducing them with new idea using latest technologies for transportation. There are many types of transportation available nowadays that can be categories as light vehicles and heavy vehicles.

Heavy vehicles can be expressed as a vehicle that has a Gross Vehicle Mass (GVM) or Aggregate Trailer Mass (ATM) of more than 4.5 tonnes and a combination that includes a vehicle with a GVM or ATM of more than 4.5 tonnes. This statement will be referred to Transport Roads and Maritime Services. There are three class of heavy vehicles, where is class I is for special purpose vehicles, class II for freight-carrying vehicles and class III for heavy vehicles. This information gets from National Heavy Vehicles Regulator sources. Truck is one of a heavy vehicle that usually use for transporting goods. In Malaysia, heavy vehicle is defined as commercial vehicle or goods vehicle that weight exceeds 5 tons.

A heavy transportation safety issue is a very serious for road authorities. Although it is not generous major accidents on the roads but heavy vehicles contribute to the highest rate of fatal accidents. In order to avoid this from getting worse improvements to heavy vehicles design and safety features need to be contribute. For this case, under-ride guard need to be design for the safety. The basic principle of an under-ride guard for heavy vehicles is to prevent small passenger cars from going underneath these heavy vehicles.

The increasing of heavy vehicle contributes to the traffic congestion in Malaysia especially during festive season or peak hour. Besides that, heavy vehicle (truck) climbing slow at the left lane up the hill is a sight that is commonly seen at any highway. The reason why heavy vehicle moving slowly is related to their performance of engine, to be exact is the efficiency of the gearbox. For this case, gearbox plays important role since it converts the rotational energy to a rotational speed suitable for the wheels. Gearbox is uses gears in gear trains to provide right speed and torque conversions from a rotating power.

1.2 Problem Statement

Nowadays, the main contributors to road accidents are involving a heavy vehicle which is causing a fatal accident. Many people get injured during under-ride accidents. An under-ride collision occurs when a smaller passenger vehicles goes beneath the heavy goods vehicle either from the front or rear or side. During such an accident the passenger compartment of the small vehicle strikes the chassis of the heavy vehicle causing severe injuries to passenger in the smaller vehicle. Statistical for road accident, heavy vehicles such as trucks accounted for 18.1 percent and accounted for 2.3 percent of the bus accident on a highway 54, 380 PLUS since 2007 until last October 2014 (PLUS Managing Director, 2014). This is negative affects to the country and must take action as soon as possible before the situation gets worse.

Besides that, accidents occur because drivers of heavy vehicles lack of awareness for the safety issues. The main problem when the driver does not take serious about the speed limit during driving. They do not care about other road users and drive with fast speed, which this is will make of truck crash. When the heavy vehicles crash with lighter vehicles, the lighter vehicles suffer bad damages which may cause mortality. This can be refer to Arlington, 2009 says that small cars generally cannot protect people in crashes as well as bigger, heavier models.

1.3 Objectives

The objectives of this project are as follows:

1. To design the rear under run protective devices and side under run protective devices for heavy vehicles such as trailer or lorry. This is because to prevent to prevent the car or motorcycle stuck under the truck when the accidents occur.
2. To study the effect of the rear under-run and side under-run protective device of heavy vehicles when the force was apply to the design. Then, study the stress on the bar by using CAD software.

1.4 Scope of Project

The scopes of this project are:

1. The drawing of barrier safety for heavy vehicles using Catia CAD software.
2. The rear and side under run protective devices will be analysing using Computer Aided Engineering CAE.
3. Calculate the impact force of the car and study the maximum and minimum Von Mises Stress of the bar when the force was apply.

CHAPTER 2

LITERATURE REVIEW

2.1 Introductions of under-run guards

Under-ride guards are steel bars that hang from the backs of trailers to prevent the front of passenger vehicles from moving underneath during a crash. These guards generally work well to prevent under-run, except in crashes occurring the outer edges of trailers, the crash tests show. Under-run accident is of three different types namely front, rear and side under-run accidents. To avoid such accidents an under-run device has to be installed on the heavy good vehicle which would prevent the passenger of the small vehicle from causing fatal injuries. In this study only focus in rear under-run and side under-run. Table 1 shows all the three type of under-run outline about the dimension.

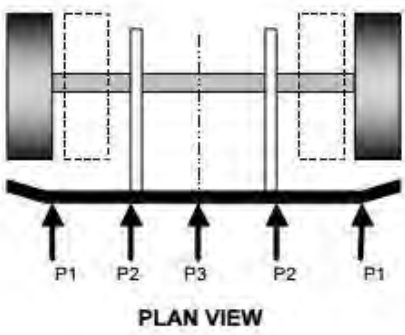

Figure 2.1: Plan view for under-run guard (Belair, 2014)

Table 2.1: Outline of the under-run guard (Belair, 2014)

Key features are summarised in the Table below.

Test Load (kN)	USA FMVSS 223/224 Rear	ECE R93: - FRONT*	E.C.E R58 : Rear barrier **	E.C.E R73 Side
outer edge P1	50 kN	80 kN	25 kN	1 kN
centre P3	50 kN	80 kN	25 kN	
off centre P2	100 kN	160 kN	100 kN	
Allowed deflection	125 mm	400 mm		30 mm in front of wheels, 300 mm elsewhere
Height	560 mm	400 mm	550 mm	550 mm

The Malaysian Institute of Road Safety Research, also known as MIROS conducted the country's first passenger car outdoor crash test at the Malaysian Institute of Aviation Technology (MIAT). The main focus was to study the effectiveness and level of damage sustained by an energy absorbing under-run protection system developed specifically for commercial vehicles. An under-run is made to absorb impact caused by a rear-end collision and it is compulsory for commercial vehicles. However many commercial vehicles out there do not even use one and most use unspecified ones.

2.1.1 Rear Under-Run Guard

Based on research before, the purpose is to reduce the amount of fatalities that occur when a small vehicle (cars, motorcycle) crush with the rear of trailers or semitrailers. The device below is the regulations for rear under-ride protections devices in United States.