

# Rethinking of some safety issues for heavy vehicles in Malaysia

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**ABSTRACT** – There are many reports in the news or other mass media about accidents involving heavy transportation in Malaysia. However, there are safety features to help avoid unexpected incidents from happening and save a lot of lives. Hence, the effectiveness of some safety features are discussed here with the body reflective marker being reviewed for improvement. Furthermore, the performance of heavy vehicles to carry loads when climbing up a hill was also analysed. The method for this project consisted of survey, analyses, calculations, and simulations. The required speed obtained can be a guide to the driver where they need to drive between the 70 km/h and 90 km/h speed range so that not to be an obstruction to other road users.

## 1. INTRODUCTION

Generally, the definition of a heavy vehicle or a commercial transportation is one that has a Gross Vehicle Mass (GVM) over 4,500 kilograms [1].

It is often reported in newspaper or other mass media about accidents involving heavy vehicles in Malaysia. This is due to some factors which should be emphasized, with the highest percentage is human factor, followed by machine factor and lastly environment.

Each type of transportation has its own unique safety features. The safety features are capable to avoid unexpected things happen such as accident in particular. Among the safety features used are passive safety, active safety, general safety, and environment where all these features are contained in the UN Regulations [2].

Furthermore, heavy vehicles safety issue is a very serious situation that need to be taken care of by other road users although it is not classified as major accidents on the roads. However, works like [3, 4] stated that heavy vehicles also contribute to the highest rate of fatal accidents. In order to avoid this from getting worse, improvements of safety features and safety speed for heavy vehicles need to be contributed. Works like Morgan [5] showed that the reflective stickers or markers may avoid up to 7,800 crashes in the US. Hence, this work would initiate further interest of its use in Malaysia.

## 2. RESEARCH METHOD

### 2.1 Survey

First of all, a survey will be conducted to get the views from respondents regarding safety features for heavy vehicle in Malaysia. This survey will consist of the statements on the use of light, light reflection sticker, and the colour of canvas for heavy vehicle.

Besides, there is also survey based on views of the use of light, light reflection sticker, and the colour of canvas for heavy vehicle. The respondents need to react to the visibility of the pictures display. Thus, the survey will be conducted online in the Google Forms and the respondents are Malaysian. Then the results were analysed to help redesign the safety features of heavy vehicle.

### 2.2 Response analysis

Analysis of the survey will discuss more about the finding. Then another survey will be made which focusing on the most significant safety features for heavy vehicles. These analyses will be shown by using bar graph and pie chart to compare the views from the respondents. The most important issue in the survey is visibility of these heavy transport vehicles especially in dark conditions as shown in Figure 2.1.



Figure 2.1 A trailer with extra lighting and stickers

### 2.3 Analytical calculations and simulations

As for the second objectives, calculation will be made to find the performance of heavy vehicle to carry loads when climbing the hill by taking the SHIERRA Hino 300, 500, and 700 Series as the model type in the study. The speed required for the heavy vehicle to climb the hill with certain load will be identified.

The simulation part elaborates the steps in doing the computer simulations on the safe speed for heavy vehicles by using ABAQUS/CAE simulation software and its Dynamic Explicit package. Since the software cannot simulate an inclined situation, the simulation treated the situations as horizontal where there are not much differences regarding the interaction of speed between cars and heavy vehicles.

### 3. RESULTS AND DISCUSSION

The survey that was done showed that most respondents agreed on the safety features for heavy vehicles as an important element to prevent accident occurrence. They also agreed on the statement where other road users will be able to see heavy vehicles clearly if safety features such as the use of lights, light reflection stickers and canvas are used properly. Figure 3.1 shows the results in the bar graph. The questionnaires prepared using Google Form include the following questions.

- Q1) Safety features for heavy vehicles is an important element to prevent accidents.
- Q2) Other road users will be able to see heavy vehicles clearly if safety features such as the use of lights, light reflection stickers and canvas are used properly.
- Q3) Mostly the additional light (side and back) on heavy vehicle is insufficient to be seen in the dark environment like rainy, cloudy and at night.
- Q4) The appearance of light reflection sticker is important as an addition lighting to the existing light on heavy vehicle.
- Q5) The use of green/dark canvas is not suitable for heavy vehicles especially at night as dark colours limit the view of other road users.

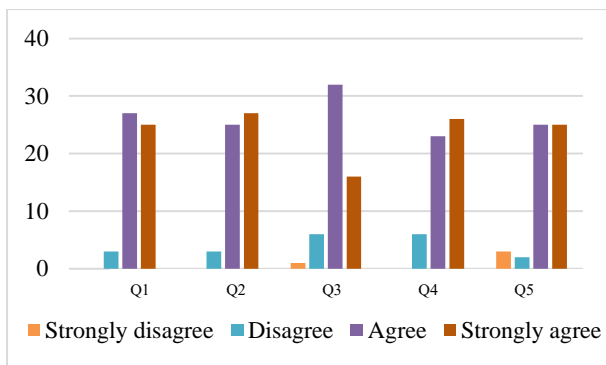


Figure 3.1 Results of the survey

The survey that have been done stated the most respondents agreed on the safety features for heavy vehicles is an important element to prevent accident occurrence. They also agreed on the statement where other road users will be able to see heavy vehicles clearly if safety features such as the use of lights, light reflection stickers and canvas are used properly.

Most respondents agreed on the appearance of light reflection sticker is important as an addition lighting to the existing light on heavy vehicle. Apart from that, they also agreed on the use of green or dark canvas is not suitable for heavy vehicles especially at night as dark colours limit the view of other road users. This initiated the need to look back at the standards for reflective stickers for trucks. Figure 3.2 shows the stickers according to the Malaysian Standards MS 828:2011 for retro-reflective stickers [6].



Figure 3.2 Markers according to [6]

Then, to make sure that heavy vehicles is safe, the performance of heavy vehicles to carry loads when climbing the hill have been analysed by taking the Hino 300, 500 and 700 Series as the model types in the study. When the car is traveling on a level road at its maximum speed  $v$ , then all of the power output  $P$ , of its engine is used to overcome the power dissipated by the resistive force  $F$ . Hence,  $P = Fv$  where the left-hand side is the power output of the engine, and the right-hand side is the power dissipated by the resistive force i.e. minus the rate at which this force does work on the car. It follows that

$$F = \frac{P}{v} \quad (1)$$

and

$$\frac{P}{v} - mg \sin \theta = ma \quad (2)$$

where  $v$  is the maximum velocity of the car climbing up the  $\theta^\circ$  incline.

Here, the left-hand side represents the power output of the car, whereas the first term represents the force dissipated by the engine and the power is spent to overcome the component of the car's weight acting down the incline. The suggested speeds like 40, 60, and 80 km/h can be studied for the drivers where they need to drive maintaining those speed to pass the hill smoothly. Muchuruza and Mussa discovered that slow vehicles – below about 65 km/h – could actually contribute a lot to road accidents [7]. Rearward collision can also be tied up to the increase in the gross vehicle weight (GVW) as noted in [8]. Hence, knowing how slow any vehicle can travel is crucial for road safety. Other road users also will move up the hill smoothly without the presence of heavy vehicles obstructing the way at the hills and the usual congestion caused by heavy vehicles also can be reduced.

In addition, the simulation on the impact analysis also have been made by using ABAQUS where the collision between car and heavy vehicle can be seen. This is also to simulate the use of safety speed between cars and heavy vehicles with different parameters such as mass and speed. The mass and speed of car is constant which are 850 kg and 120 km/h respectively. The results for a light truck that is 8500 kg are as listed in Table 3.1.

Table 3.1 Results from the impact simulations

Velocity (km/h)	Max Stress (MPa)	Min Stress (MPa)
80	475.3	0.6519
60	417.2	0.0017
40	485.4	0.1478

Even when the heavy vehicle is traveling at 80 km/h, the stresses caused from the impact may exceed 400 MPa, which is enough to cause catastrophic damage to the car's front portion. Since, there are reports of very slow speed being a cause for road accidents and very high speed goes without saying, the suggested speed to travel for commercial vehicles is between 70 km/h and 90 km/h.

#### 4. SUMMARY

Thus, the safety features that need to be emphasized in redesign or recommend change is light reflection stickers. This is because light reflection stickers can be an additional source of lights besides the lamp on heavy vehicles. Although the lights on heavy vehicles in not sufficient, light reflection stickers can be an aid to light the heavy vehicles if the light reflection stickers are used properly. As for the canvas used, it is insignificant since the canvas is slightly up above the view of human eyes so this is no need to redesign in urgent.

Current light reflection stickers that followed Malaysian Standard which is MS 828:2011, is good enough but it need to be much larger to be seen clearly and the material used is not reflected. So the new design will use retroreflective sheeting. Since there is no budget for this master project as well as the time to complete this thesis is limited, the recommended changes in design of light reflection stickers can be seen in Figure 4.1 below.

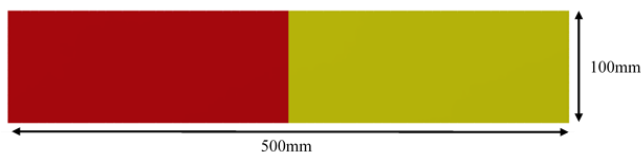


Figure 4.1 New design of light reflection stickers

By executing the ABAQUS simulation, the conclusion can be made as the slower the speed the higher the stress faced by the car's bumper and its condition will become worse. However, the displacements of the cars cannot be done since the time to complete this master project is limited in order to explore more about this part.

Besides, the heavier the heavy vehicles the slower it is moving and the more dangerous it could be to the other road users. The final value of stress is decreasing because the car is retracted from rear-end of heavy vehicle as the crash is stopped. The step time also decrease because the slower the velocity the quickly the car hit rear-end of heavy vehicles.

Apart from that, the condition of car at the final crash become more smashed up as the velocity is decreasing. If this simulation is occurring in real life for sure the passengers on the cars losing their life or be in

really bad condition. So this analysis is important to save and prevent any unexpected incident occur to road users and other vehicles by giving the heavy vehicles a guideline for using the safety speed as well as the safety features on them.

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