Simulation and Analysis on the Effect of Gross Vehicle Weight on Braking Distance of Heavy Vehicle

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Abstract: Increasing number of fatalities caused by road accidents involving heavy vehicles every year has raised the level of concern and awareness on road safety situation in developing countries like Malaysia. This study attempts to explore the influences of vehicle dynamics’ characteristics such as vehicle weight and travel speed on its safety braking distance. This study uses a kind of complex virtual prototyping software to simulate vehicle dynamics and its braking performance characteristics. The software was used to generate braking distance data for various vehicle types under various loads and speed condition. The generated data was grouped according to GVVW and then analyzed by two-way ANOVA to evaluate its relationship to braking distance. The finding of this study implies that the speed and GVVW of various vehicle classifications has a significant effect to the heavy vehicle braking distance.

Introduction

Road accidents are complex events, often resulting from multiple contributing factors. Human behaviour, the roadway environment and vehicle failure are factors found to contribute approximately 94%, 34% and 12% to vehicle crashes, respectively [1]. An analysis of traffic accidents indicates that human factor is a contributing factor to road traffic accidents [2]. Human factor involved in large-vehicle crashes can be subdivided into various forms. The most common critical error made by drivers, whether they are truck drivers or other involved drivers, appears to be the judgement of the safe distance gap, which is due to drivers following too closely to the leading vehicle and are over confident in their ability to stop the truck before it crashes [3]. Most drivers consider themselves above average in terms of driving skill. A number of studies conducted in various countries around the world demonstrate that up to 90% of drivers think they are an above average, low-risk driver [4]. For that reason, drivers believe they can travel above the speed limit and not place themselves at high risk.

The consciousness of the safe distance gap is very crucial for heavy vehicle drivers to prevent collision with the vehicle in front. Therefore, some countries have imposed rules concerning the minimum time gap or distance gap between two vehicles on the road to prevent front-end and rear-end collision. For instance, in Netherlands, fines can be imposed if the distance between the two vehicles is less than 1 second. In Norway, for vehicles weighing more than 3.5 tonnes, a distance of between 0.5 and 1 second can lead to a suspension of the driver’s license for 3 to 6 months. In South Australia, the Driver’s Handbook describes 2 seconds as a reasonably safe distance [5].

Braking distance (BD) is the distance taken for a vehicle to stop from a specific speed without considering the driver’s reaction time. The ability of a vehicle to achieve short braking distance under variables of speed and load is an essential aspect of heavy vehicle (HV) safety. One observation made regarding the parameter considered in most theoretical formula for braking distance that have been proposed is that, all the models only consider the speed of the vehicle. The other important independent parameters for HV such as vehicle classification and GVVW, which may have a direct impact on vehicle braking performance, have not been explicitly considered. The characteristic of this important HV parameter is assumed to be the same for all types of vehicle.