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Transportation Research Procedia 21 (2017) 18–28

Transportation Research Procedia

www.elsevier.com/locate/procedia

2016 International Symposium of Transport Simulation (ISTS'16 Conference), June 23~25, 2016

Heavy Vehicle Management: Restriction Strategies

Mohammed Al Eisaeia, Sara Moridpourb, Richard Tay*

[a]*Mohammed Al Eisaei, Civil, Environmental and Chemical Engineering, RMIT University, Melbourne, 3001, Australia*
[b]*Sara Moridpour, Civil, Environmental and Chemical Engineering, RMIT University, Melbourne, 3001, Australia*
[c]*Richard Tay, Business, IT and Logistics, RMIT University, Melbourne, 3001, Australia*

Abstract

Road freight transport is considered as an important aspect of the Australian economy. Due to the operational characteristics (e.g. acceleration/deceleration, manoeuvrability) and physical specifications (e.g. length, size) of heavy vehicles, they impose negative impacts on surrounding traffic. These negative impacts include increasing traffic congestion, reducing traffic safety and increasing air and noise pollution. The negative impacts imposed by heavy vehicles would be intensified at arterial roads due to the presence of traffic lights when heavy vehicles have to decelerate at the red light, stop and then accelerate again. Considering the negative impacts of heavy vehicles on their surrounding traffic, suitable management strategies should be implemented to accommodate the increase in number of heavy vehicles. A typical method of managing heavy vehicle movements is through implementing alternative heavy vehicle restriction strategies. The main focus of this paper is to address the influence of heavy vehicle space restriction strategies for different classes of heavy vehicles on traffic congestion. In this research heavy vehicles have been classified into three classes including Rigid, Heavy Combination and Multi Combination. The road section that is used in this research is a section of Princes Highway in Melbourne, Australia. This section is 8.8 km long and 13 signalised intersections exist within that distance. To ensure accurate evaluation of the restriction strategies, VISSIM traffic simulation software is used. The study area is modelled in VISSIM. Afterwards, the restriction strategies are applied to the VISSIM model where certain classes of the heavy vehicles will be banned to use the road during the peak period. Four different heavy vehicle restriction strategies are applied in this research. The first strategy is having no restriction for heavy vehicles. The second strategy will apply restrictions on the multi combination class only. The third strategy will apply restrictions on both multi combination and heavy combination classes. The fourth strategy will restrict all classes of heavy vehicles. The effects of each restriction strategy on different traffic measurements will be evaluated at different heavy vehicle compositions. Restricting all heavy vehicles was deemed the most efficient restriction strategy in terms of the traffic performance measures used in this study.

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Selection and Peer-review under responsibility of Dept. of Transportation Engineering, University of Seoul.

Keywords: traffic flow theory, fundamental diagram, GPS-equipped probe vehicle, trajectory

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10.1016/j.trpro.2017.03.074

1. Introduction

Between the years 2009 and 2014, there has been an increase of approximately 15% in the number of registered heavy vehicles in Australia (AustralianBureauofStatistics, 2014). Alternative heavy vehicle restriction strategies have been put in place in an effort to reduce the negative impacts of heavy vehicles on the surrounding traffic. One of the most common strategies which are currently in practice is space restrictions or lane restrictions, where heavy vehicles are usually restricted to the use of designated lanes. Time restrictions form another type of restriction strategy, typically restricting the movement of heavy vehicles on a certain road during peak periods. The main objective of applying such restriction strategies is to achieve an efficient transport network in terms of delay time and the enhanced safety that could be achieved by separating heavy vehicles from other types of vehicles. In this study, restriction strategies were implemented based on the heavy vehicle type. As different types of heavy vehicles exist, their negative impact on the surrounding traffic varies due to different physical specifications (size and length) of each heavy vehicle type.

This paper will examine relevant literature in the second section of the study and address the limitations which have been found. The third section will present the data set which has been used in this study along with a brief description of the study area. The fourth section will explain the model development in VISSIM and the application of the restriction strategies. The fifth section of the paper will present the results achieved from applying the restriction strategies under different heavy vehicle compositions. The sixth and final section of the study will provide the main findings of the study and future directions.

2. Literature Review

Hoel and Peek (1999) evaluated the differences between having heavy vehicle lane restrictions and not having any restrictions on highways. The aim of the study was to simulate both lane management strategies and assess the operational and safety impacts of applying lane restrictions. In their study, the authors selected the I-81 corridor in Virginia, USA as their case study since it carried a high percentage of heavy vehicles. The corridor's traffic data was acquired using loop detectors, and all of the necessary traffic counts for each vehicle classification were attained. The authors selected the FRESIM simulation software as their tool to simulate the lane restriction strategies, and the following represented the performance measures which were used to evaluate the model: density, lane changes per vehicle and speed differential. The two lane management strategies that were compared in the study were having no lane restrictions against having trucks restricted from the left lane, and having no lane restrictions against having trucks restricted from the right lane. For analysis validity, the authors used the paired sample t-test to determine the significance of difference between the lane restriction strategies. After analysing the results obtained from each scenario using the sample t-test; the authors concluded with three recommendations based on the attained results. The first recommendation was to restrict heavy vehicles from the left lane on roads with 4% grades or higher. They came to this conclusion based on the speed differential performance parameter; where the results showed an increase in the speed differential between heavy and light vehicles in this lane management strategy. The second recommendation was not to restrict heavy vehicles from the right lane, due to the results which showed an increase in lane changes; and having increased lane changes indicates increased safety issues on the road. The final recommendation mentioned by the authors was to retain any effective left lane restrictions, since the results obtained from this study did not exhibit disadvantages from this lane management strategy.

Mugarula and Mussa (2003) analysed the operational impacts of applying a left lane heavy vehicle restriction on the 3-lane, I-75 corridor in the United States of America; using the microsimulation software CORSIM. The length of approximately 224 km of the corridor was analysed in the study. Telemetered traffic monitoring devices situated on the corridor were used to acquire the relevant traffic data that were input into CORSIM. Average volumes, entrance volumes, exit volumes and percentages of heavy vehicles were the traffic characteristics that were input into CORSIM. The day period was set between 06:00AM-06:00PM, while the night period was set between 06:00PM-06:00AM. Ten scenarios were developed by modifying the traffic characteristics and each scenario was compared using performance measures. The performance measures which

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