

EFFECTS ON TRAFFIC FLOW DUE TO THREE-WHEELERS PARKING NEAR ROAD INTERSECTIONS

U. A. Gopallawa¹ and K. S. Weerasekera²

^{1, 2}*Department of Civil Engineering, The Open University of Sri Lanka*

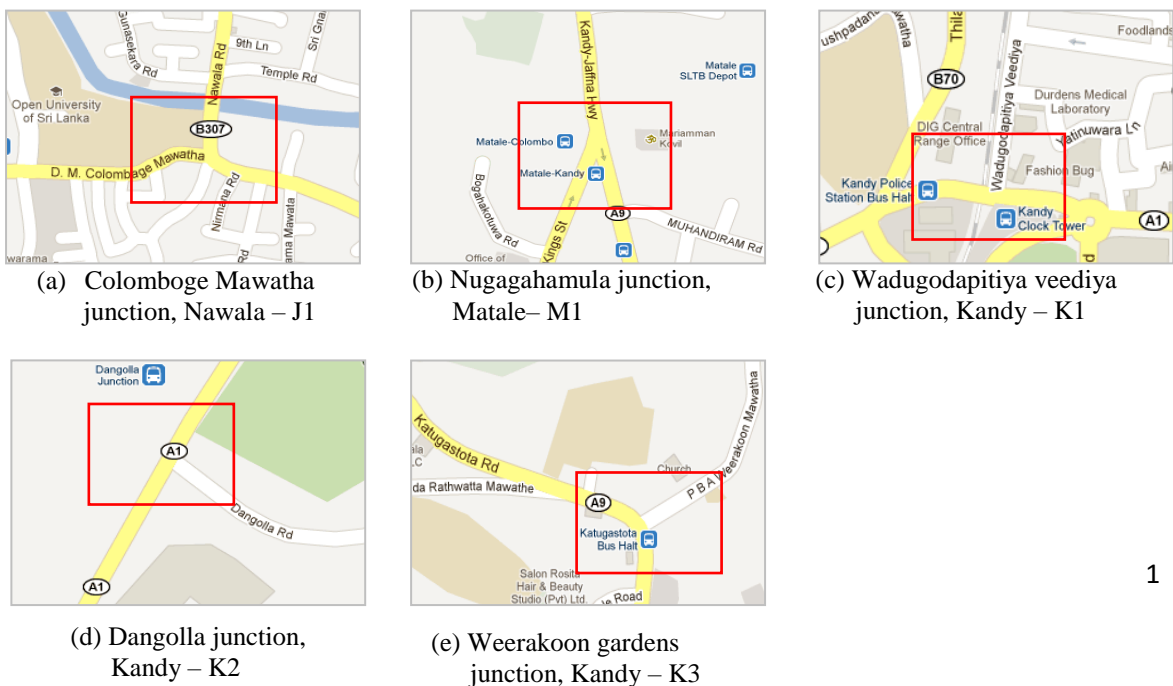
INTRODUCTION

Three-wheelers have rapidly become a popular mode of transport in Sri Lanka during last three decades. This mode of transport became popular due to its free availability, less road space occupation, low travel and maintenance cost. Due to these reasons and its comparatively low purchase cost, people are tempted to purchase or hire three-wheelers for their day to day travel. The annual growth rate of three-wheelers is 15.4% as per Department of Motor Traffic statistics.

Three-wheelers are mostly used for hiring purposes as an alternative for taxis. Three-wheeler operators obtain assigned parking areas from the municipal council or urban councils. It could be seen that municipal councils and urban councils are in the habit of permitting three-wheelers to park near road intersections of congested city/town roads. This leads to visibility obstruction at intersections, reduce road capacities, and bottle-necks the approaches of the intersection, causing inconvenience to both pedestrians and drivers, affecting the smooth flow of traffic. Through-put of the intersection may also reduce causing accidents at these locations (Weerasekera, 2009).

Through this study it is expected to investigate any negative effects on average delays and exit rates to minor road vehicles, accident effects etc. due to the three-wheeler parks near road intersections. Five road intersections from *Kotte*, *Kandy* and *Matale* municipal areas were selected for the study (Figure 1). These study locations were selected in such a way that they had no external effects other than the direct effect due to the presence of three-wheeler parks near road intersections.

Figure1-Selected study locations



METHODOLOGY

- Collected information from the municipalities, urban councils any other permit issuing institutions about any rules, regulations or guidelines for permitting three-wheeler parks.
- Collected accident data from *Mirihana*, *Kandy* and *Matale* police stations before and after implementing three-wheeler parks near road intersections.
- Conducted traffic surveys and studied traffic flow patterns to observe exit rates and average delays at intersections.
- Analysed results and quantified the effects on exit rate and average delay.
- Conclusion and proposed recommendations for effective three-wheeler parks.

Data collected from municipal councils

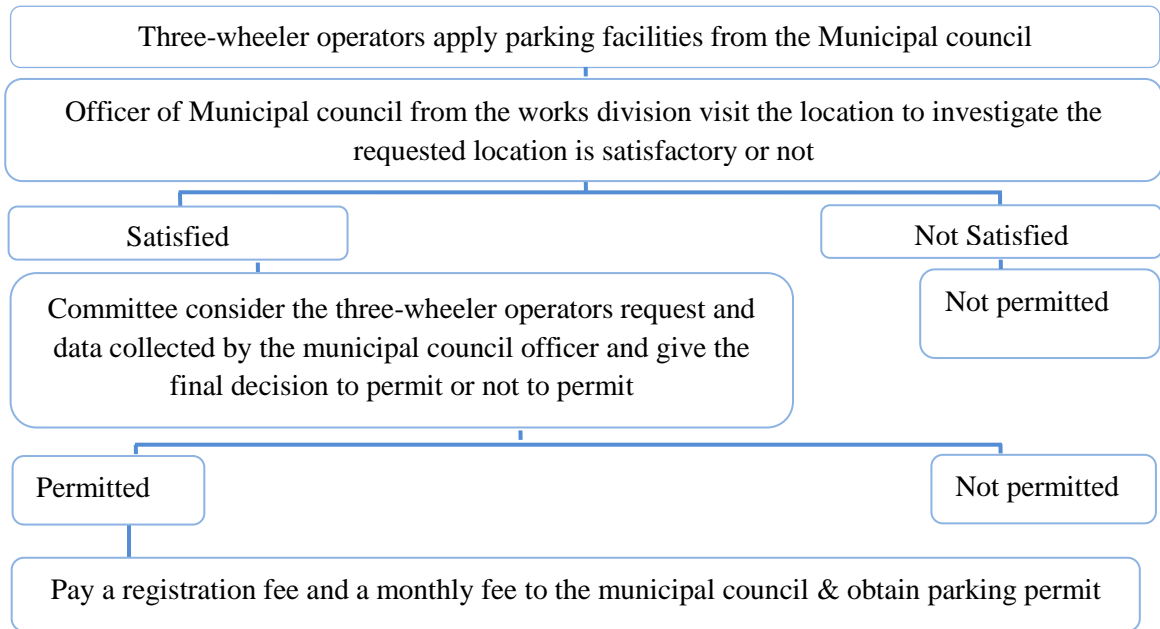


Figure 2 – Procedure adopted for permitting three-wheeler parks

It's seen that when permitting three-wheeler parking near road intersections effects on pedestrians, vehicular flow, and reduction of carriageway widths etc. are not considered.

Accident details

Past accident records from *Kandy*, *Mirihana* and *Matale* police stations indicate that there is a considerable increase of accidents at all locations after implementing three-wheeler parks.

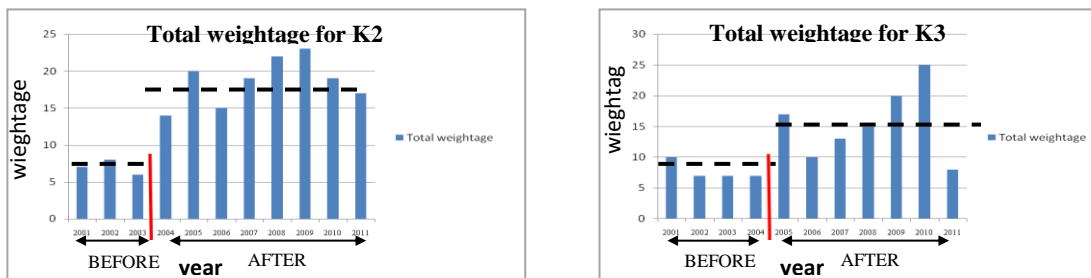


Figure 3 – Accident weightage for K2 and K3 locations

Traffic surveys

The traffic surveys were conducted for three hours at each location, to study the traffic flow patterns at all the 5 selected study locations. The exit rates and the vehicular delays of the studied intersections were calculated by using the data collected from the traffic surveys by using Tanner model (1962). Data collected from traffic surveys as follows:

- Major and minor road flow - The number of vehicles in traffic flows of major and minor roads was collected. All the counts were done in 5 minutes intervals.
- Identification of minimum following time of major road vehicles (β_1)- Time headway between the front and rear vehicle of bunch of vehicles which are following each other were observed when passing a selected point on the road. The number of vehicles which were included in each bunch was also counted separately. This was carried out for 100 samples at each location. Then the average time headway was calculated.
- Number of vehicles entering the major road - Number of vehicles which were entering the major road was observed in 5 minutes intervals.
- Vehicular delay - Registered number of each vehicle and the time was recorded when it joined the minor flow vehicle queue, and when it entered the major flow respectively. The difference of the above mentioned times were calculated to find the delay of each vehicle.
- Number of three-wheelers - Number of three-wheelers parked in the three-wheeler park was recorded at each 5 minutes interval.

ANALYSIS

Exit rate and average delay analysis

Exit rate - number of vehicles per hour in a minor stream that can enter a major stream was calculated using the following equation which was developed by the Tanner (1962).

$$C = 3,600 \frac{q_p e^{(-q_p t_a)}}{1 - e^{(-q_p t_f)}}$$

Where, C = the exit rate from minor road
 q_p = the major (priority) stream volume in veh/sec
 t_a = the critical acceptance gap in seconds
 t_f = the follow-up headway in seconds

Average delay-Tanner's formula for the average delay to minor road vehicles due to the vehicles on the major road, when the system is in statistical equilibrium was used to calculate average delay at each intersection is as follows.

$$w_2 = \frac{1/2E(y^2)/Y + q_2 Y e^{(-\beta_2 q_1)} [e^{(\beta_2 q_1)} - \beta_2 q_1 - 1]/q_1}{1 - q_2 Y [1 - e^{(-\beta_2 q_1)}]}$$

Where,

$$Y = E(y) + 1/q_1$$

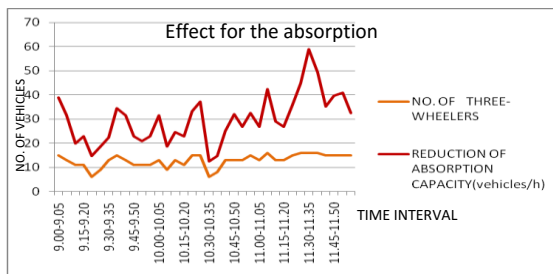
$$\beta_2 = \frac{112.02}{100}$$

$$E(y^2) = \frac{2e^{[q_1(t_a - \beta_1)]}}{q_1^2 (1 - \beta_1 q_1)^2} e^{[q_1(t_a - \beta_1)]} - t_a q_1 (1 - \beta_1 q_1) - 1 + \beta_1 q_1 - \beta_1^2 q_1^2 + \frac{1}{2} \frac{\beta_1^2 q_1^2}{(1 - \beta_1 q_1)}$$

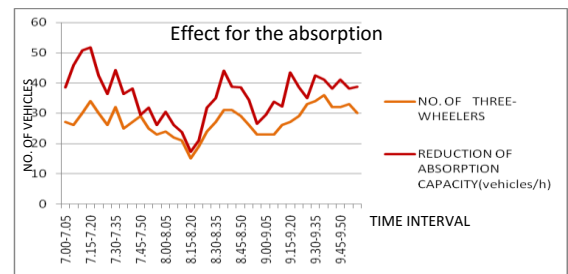
- q_1 = arrival rate on major road
- q_2 = arrival rate on minor road
- β_1 = minimum following time of major road vehicles
- β_2 = move-up time of minor road vehicles
- t_a = critical acceptance gap

RESULTS AND DISCUSSION

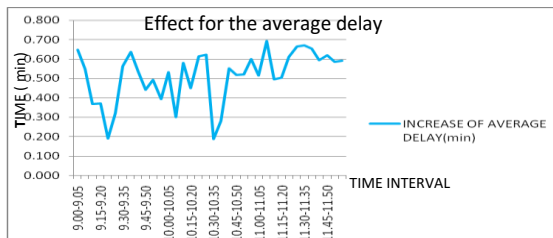
According to the results there is a considerable reduction in exit rate and increase in average delay. When the number of parked three-wheelers increased, reduction of exit rate and increase in average delay was noticeable (see Figure 4).



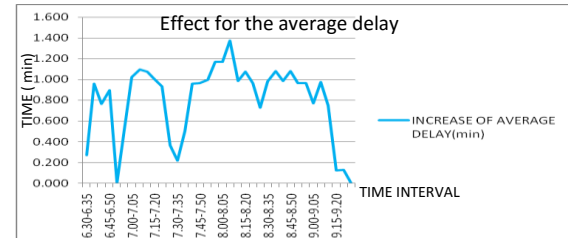
K1 study location



K2 study location



K1 study location



K3 study location

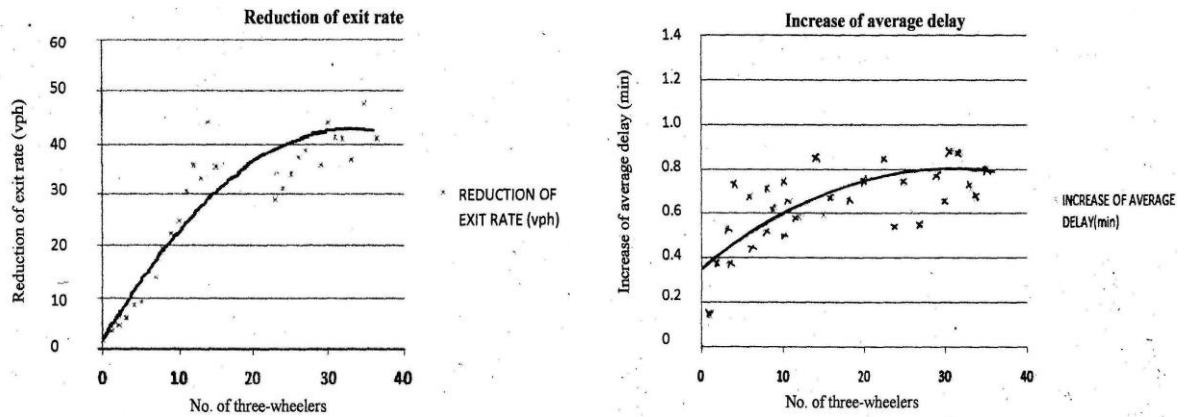


Figure 4- Effect on exit rate and average delay

CONCLUSIONS

This study confirms that three-wheeler parks near intersections do have an impact on average delay and exit rate from minor road vehicles. There was an increase in the average delay and a reduction in exit rate for vehicles on minor roads when three-wheelers park near intersections.

REFERENCES

- Tanner, J. C. (1962) 'A Theoretical Analysis of Delays at an Uncontrolled Intersection', *Biometrika*, Vol.49, Nos 1 and 2.
- Weerasekera, K. S. (2009) 'Bridging the Gap towards Safer Roads – What is in between?', Proceedings of the UN-ESCAP Workshop on Developing Road Safety Strategy & Goals, Ministry of Highways and Road Development, Government of Sri Lanka, 3rd December 2009.