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Experimental study for estimating capacity of cycle lanes

Sebastian Seriani[a,*], Rodrigo Fernandez[a], Esteban Hermosilla[a]

[a]*Universidad de los Andes, Mons. Álvaro del Portillo 12445, Las Condes, 7620001, Santiago, Chile*

Abstract

Today some cycle lanes are reaching high levels of flow. Clear examples are the cycle-track Pocuro in Santiago de Chile and the cycle-lane Tavistock Square in London. The problem presented in this research is the lack of measurements for estimating the capacity of cycle lanes at traffic signals. Therefore, it cannot be identified through indicators whether cycle lanes are saturated or not. For this reason there is no record of the capacity they can offer. As a methodology we established four steps. Firstly, we measured the physical and operational variables of cycle lanes, and we investigated about international studies related to their capacities. Then we used the approach of the Road Note 34 (RRL, 1963) to measure the saturation flow and transient periods of cycle lanes, taking as case study Santiago de Chile and London. In addition, we defined different scenarios of experiments. Finally, the results were transformed into design recommendations to provide an adequate level of service for cyclists. The main results of this research shows that the saturation flow grows almost linearly with the width. When cyclists formed in lanes, the saturation flow increased only if a new lane was formed. In the case of the cycle-track Pocuro, for a width of 1.0 m the saturation flow reached 2070 bicycle/h-lane. If the width increased to 2.0 m, the saturation flow reached 4657 bicycle/h-lane. In relation to Tavistock Square, this cycle-lane (width of 1.0 m) reached a saturation flow of 4320 bicycle/h-lane. As a conclusion, this research can be used by traffic engineers to estimate the saturation flow of cycle lanes and delays of cyclists at traffic signals. This in turn can help in designing cycle facilities at transport infrastructures. The validation of our investigation can also help transport planners with the calculation of the capacity, optimum width, comfort, and other operational costs of cycle lanes.

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Keywords: cycle lanes; cycle tracks; cyclists; saturation flow; capacity.

* Corresponding author. Tel.: +56-22-6181302.
E-mail address: sseriani@miuandes.cl

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1. Introduction

Today some cycle lanes of Santiago are reaching high levels of flow. According to the consultant Urbanism and Territory (2013) cycling is growing at a rate of 20% annually. This is observed mainly at peak hours which occur between 7-10 am when cyclists are heading to their jobs, schools or universities, and in the afternoon between 19 – 21 pm when returning home.

Clear examples of high flow of bicycles in Santiago are the cycle-track Pocuro, cycle-track Andres Bello, cycle-lane Antonio Varas and cycle-lane Simon Bolivar. Similarly, in developed cities like London, where 2% of the trips per day are done by bike (TfL, 2011), there are also some cycle lanes reaching high levels of flow, for example the cycle-lane Tavistock Square.

The problem presented in this research is the lack of measurements for estimating the capacity of cycle lanes at traffic signals. Therefore, it cannot be identified through indicators whether cycle lanes are saturated or not. For this reason there is no record of the capacity they can offer.

According to Akcelik (1995) the saturation flow in vehicles is a basic characteristic to calculate the capacity of a traffic signal approach during a typical signal cycle (C). For a given junction approach, the saturation flow is defined as the maximum discharge rate of a queue of vehicles during the effective green time (g) of that approach, as shown in Fig. 1. At the start of the green period (G) there is a transient period ($\lambda 1$), called start loss, before the discharge rate reaches its maximum, which is the saturation flow (S) for that approach. If the queue remains until the start of the amber time (A), there is another transient period ($\lambda 2$), called end gain, until the start of the red time (R). Thus, the effective green time is defined as $g = G - \lambda 1 + \lambda 2$. The value of the saturation flow and transient periods depend on both the traffic composition and geometry of the junction approach. The curve shown in Fig. 1 comes from the discharge of a queue of vehicles from a traffic signal which remains until the start of the red period. This sort of traffic behavior is obtained if there is no blockage downstream the stop line; e.g., the downstream street is not blocked by the back of a queue of vehicles which may reduce the discharge rate.

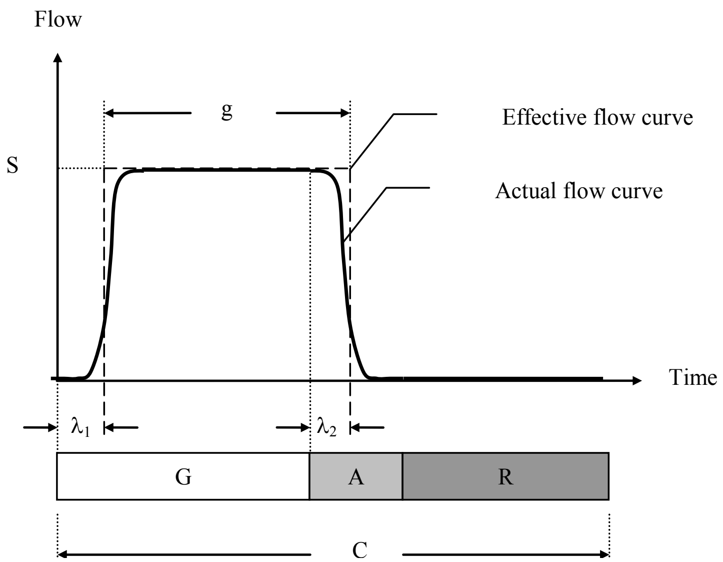

Fig. 1.Typical flow discharge at a traffic signal.

The flow-time curve shown in Fig. 1 indicates that not all vehicles in a queue take the same time to cross the stop line at a traffic signal. The question posed by this piece of research is: Could the same behavior occur in cycle lanes? Our hypothesis is that the same sort of discharge curve of cyclist can be found at cycle lanes.