



Saturation Flow Rate Analysis at Signalized Intersections for Mixed Traffic Conditions in Motorcycle Dependent Cities

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Abstract

This article describes the results of a comprehensive saturation flow rate analysis at signalized intersections in motorcycle dependent cities. So far, available methods of capacity analysis do not consider the specific conditions of driver behavior and traffic flow which are dominant e.g. in Vietnam or other countries where motorcycles have the major share in the traffic. Consequently, there is a need to develop a proper method for such saturation flow rate analysis. The methodology of this research was developed under the specific traffic situation in Ho Chi Minh City, Vietnam, a motorcycle dependent city (MDCs). Saturation flow rate models using regression method are presented and described. The term of Motorcycle Unit (MCU) is introduced, and factors which mainly affect the saturation flow in such mixed conditions are considered. Finally, a procedure to calculate the saturation flow rate for specific traffic situations is provided. The conducted research indicates that the proposed saturation flow rate analysis model is an appropriate approach to calculate the saturation flow rate for traffic streams at signalized intersections under such mixed traffic conditions.

Keywords: Motorcycle dependent cities, motorcycles, motorcycle unit, saturation flow rate

1 Introduction of Motorcycle Dependent Cities

The term “motorcycle city” was adopted firstly by Barter (1999) [1] to define the urban transport and land use situation, but the term was used without the corresponding indicators, except some discussions on motorcycle ownership. Then, Khuat (2006) [2] proposed three main indicators: vehicle ownership, availability of alternative, and use of motorcycle to identify the motorcycle dependent level. A typical motorcycle dependent city (MDCs) should has some characteristics such as: motorcycle ownership is higher than 350 per 1000 inhabitants; private car ownership is lower than 150 per 1000 inhabitants; public transport availability is lower than 1 bus per 1000 inhabitants; modal split of

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motorcycle is higher than 40%, while modal splits of private car and public transport are lower than 20%, and modal split of non-motorized transport is about 30% to 50% [2].

2 Fundamentals of Saturation Flow Rate

2.1 Definition of Saturation Flow

According to Webster and Cobbe (1966) [3], the saturation flow rate is the flow which would be obtained if there was a constant queue of vehicles and they were given a 100 percent green time. It is generally expressed in vehicles per hour of green (vphg).

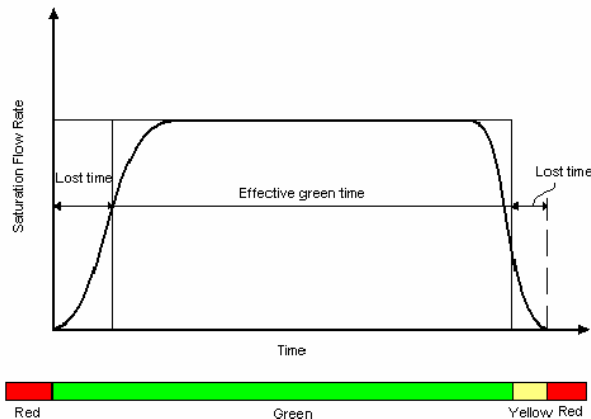


Figure 1: Variation with time of discharge rate of queue in a fully saturated green period

Source Webster and Cobbe (1966) [3]

The conventional graphical representation of the saturation flow is shown in Figure 1. The solid line in the figure shows the traditional concept, which assumes after a few seconds following the beginning of the green time, traffic discharges at a constant rate (the saturation flow rate) until the queue is discharged, when a sharp decrease in the flow occurs. The departure rate is lower during the first few seconds, while vehicles accelerate to normal running speed, and after the end of the green interval, as the flow of vehicles declines.

Through decades, the term of saturation flow was changed by different researchers. The Highway Capacity Manual (HCM) [4] describes the saturation flow rate as the flow, in vehicles per hour per lane, that can be accommodated by the lane assuming that the green phase is always available to the approach. The Canadian Capacity Guide for Signalized Intersections (CCG) [5] defines saturation flow as the rate of queue discharge from the stop line of an approach lane, expressed in passenger-car units per hour of green (pcu/hr green). Australian Road Research Board (ARRB) Report 123 [6] defines saturation flow as the maximum constant departure rate from the queue during the green period, expressed in through-car units per hour (tcu/hr).

2.2 Saturation Flow Rate Models

The Saturation flow rate at signalized intersections is computed based on the basic procedure: at first saturation flow rate in ideal condition would be determined and then affecting factors which reflect the difference between the ideal condition and the actual condition would be added. Different countries decided to put different influencing factors into their model to make the model suitable with their specific traffic conditions.

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