UNIVERSITI TEKNOLOGI MARA

DEVELOPMENT OF WEAVING SECTION FLOW MODEL OF CONVENTIONAL ROUNDABOUT

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ABSTRACT

Roundabout has been used and becomes popular in sub-urban residential areas as one of a viable traffic control system at intersections. At roundabout vehicles need to make a circulatory movement before exiting to their respective directions without having to stop, thus minimize delay. Studies on roundabout capacity and performance mostly focus on geometric configuration and flow at the entry, on the basis and acceptance of offside priority rule. Studies had shown that offside priority is most appropriate and efficient with small and mini roundabout. As for conventional roundabout or those with inscribe diameter D_I > 50 m, the approach may give rise to differences in predicted capacities. This may be due to the phenomenon of flow interactions (driver behaviour related to lane selection and changing) at the weaving section, and this seems to be the 'gap' in present knowledge on roundabout capacity prediction. Inefficient traffic movement within the weaving section may affect discharge flow, and hence capacity at entry. As such it seems more appropriate to study and measure flow at the weaving area. Thus, this research focuses to understand and study the dynamic as well as complex traffic behaviour/interaction in the weaving section of conventional roundabout, and to give a measure (model) of weaving flow capacity. A typical 4-legs 2-circulatory lanes conventional roundabout was selected with video recorder set-up to capture traffic movements on one of its weaving section. Field data were collected during weekdays which cover both the morning and afternoon sessions. Data reduction was done using semi-automatic vehicle analyser (SAVA) software. Using Excel the raw data (vehicles types, pattern movement and time gap) were organised and tabulated. Statistical tools from MiniTAB were used for data screening and verification. Traffic flow at weaving section which exhibits dynamic and complex behaviour/interaction can be modelled (Q_{wsf}), that comprises through (non-conflicting Q_{ncf}) and weaving (conflicting Q_{cf}) movements. These flow patterns are critically governed by the available gaps between vehicles, thus time ideal safe gap (T_{isg}) been identified and retrieved. With the available data, data transformations and rigorous statistical tests were done during the model development process. Statistical tables and graph plots revealed the good correlations, relationships and significances between the variables/parameters being considered. The developed model ($Q_{wsf} = 2700 + 0.000028\ Q_{ncf}^{3/2}.Q_{cf} - 1.22T_{isg}\ .Q_{cf}$), was calibrated, verified and validated with independent field data (new data set). Comparison of weaving flow capacity between the develop model and observed/field data was within approximately 5% difference. Sensitivity analysis was done to check on the measured of effectiveness (MOE) of the model. Integration between weaving section flow and practical capacity flow enable level of service (LOS) chart being deduced. The LOS chart is considered another significant contribution of this research to practising traffic engineers and academicians. Knowledge on the mechanics of traffic flow interactions at weaving section and the developed model are able to give better prediction on weaving capacity as well as performance level and, hence, the objectives set for this research works were accomplished.

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CHAPTER ONE
INTRODUCTION

1.1 BACKGROUND OF STUDIES

Roundabout is an intersection that provides a circular traffic pattern with significant reduction in the crossing conflict points. *Arahan Teknik (Jalan)* 11/87 (1987) categorised roundabout as conventional, small and mini depending on the size of the inscribe diameter. As for conventional roundabout the prescribe inscribe diameter should be $D_I > 50$ m. Roundabouts are more appropriate where traffic volume are about constant and below capacity with all-legs have approximately equal amount of flow. Thus, this form of intersection is quite common in sub-urban residential areas that have less restriction on land and may add aesthetic to the environment.

Studies of roundabout have been done by many researchers and most works focus at the entry with respect to its flow, gap and geometric design. To-date it was found that very few studies have directly addressed the flow, gap and geometric design issue at the circulatory roadway especially at the weaving section of roundabout. However, recent studies from Hagring et al. (2003) did mentioned that "the lane allocation of circulating flow did have a significant impact on capacity, particularly at large circulating flow rates." Current study would investigate the phenomena of circulating flow at weaving section on the capacity.

Chik et al. (2004) mentioned that in the early stage, Wardrop (1957) had developed the roundabout capacity formula based on a weaving section of roundabout. Wardrop (1957) formula only consider geometric design parameter and proportion of weaving section flow, without any explanation on the complex activities (lane selection and lane changing) that involve in the weaving section. It can be expected that inefficiency of these manoeuvres in the weaving section may create slow down in flow to the discharge or exit points, hence affect the entire system such as 'lock' movement. Thus, knowledge and understanding of the mechanic of movements at weaving section is crucial for effective movement at roundabout system, and this is what this study would like to address.