論文の内容の要旨

Study on geometric and control design of at-grade crossing facilities for vehicle-pedestrian urban network

（都市部車輌・歩行者ネットワークにおける平面交差施設の幾何構造と交通制御設計に関する研究）

Muhammad Abdullah

ムハッマド　アブドッラ

Pedestrian crossing facilities, whether located at intersections or at midblock locations, are an important factor for better pedestrian walkability. They improve connectivity, accessibility and continuity of the pedestrian network. Existing design manuals, however, generally provide guidelines about locating crosswalks from safety viewpoint only. Moreover, traditionally crosswalks are usually taken as exogenous inputs and the network performance is maximized subsequently.

Aside from their impact on pedestrian efficiency and safety, crosswalks can affect vehicle efficiency too. For example, crosswalks converge pedestrians to a particular location and reduce crossing time which in turn increases the vehicular capacity of the road. Presence of multiple crosswalks distributes the pedestrian demand and reduces the delay. Midblock crosswalks may impact the vehicular progression and queues may reach a crosswalk if it is located too close to an intersection. Pedestrians crossing at intersection crosswalks may impede the turning vehicle flow especially when either the pedestrian or

turning vehicle volumes are high. Therefore, it is important to optimize the placement, quantity and signal settings of crosswalks in a network so as to maximize the network performance for both vehicles and pedestrians.

The primary objective of this research was to maximize the performance of networks for both vehicles and pedestrians by incorporating pedestrian crossing facilities into the optimization framework. The secondary objective is to explore pedestrian risk taking behavior at midblock locations in order to determine whether or not it is necessary to optimize the pedestrian crossing facilities from unobservable factors viewpoint. Another secondary objective is to evaluate the performance of a particular scenario where crosswalks are removed from critical intersections and placed at midblock locations.

A self-reported survey was conducted in order to explore the pedestrian crossing behavior at unmarked midblock locations. The results showed that pedestrians undertake risk taking behavior at midblock locations especially at urban and local roads and may cross at unmarked midblock locations when marked crosswalk is far. Hence, the study indicated that it is important to optimize the location of pedestrian crossing facilities in order to prevent pedestrian risk taking behavior. In order to achieve the primary objective, a delay minimization problem for a network was formulated so as to optimize the crosswalk existence, quantity, location and signal settings. The optimization model follows system optimum principle and can be used for planning purposes. Further, an integrated approach involving pedestrian route choice behavior was developed. The optimization formulations proposed in this study are an improvement on the traditional approaches where vehicle and pedestrian efficiency is maximized by keeping the crosswalk related design parameters as fixed inputs. The results showed how distributing the pedestrian demand along several crosswalks can reduce the burden at intersections

and improve the efficiency especially for turning vehicles. Moreover, intersections can be operated at shorter cycle lengths and still serve the demand. The performance of the alternative crossing design was evaluated using a simulation and optimization package. The relative applicability of this alternative crossing design and the traditional crossing designs at such intersections is also determined. Alternative crossing design outperformed traditional crossing design for busy intersections and stayed undersaturated even for higher vehicle and pedestrian demands.