Research on the Traffic Improvement Measures for Large Intersections

Dong Bo LIU, Yun Xia WANG, Jing Yi HUA
Traffic management research institute of the ministry of public security, Wuxi 214151
Email: wangyunxiahc@126.com

Abstract. The rate of accident at large intersections is often much higher than that at regular intersections. Besides, the traffic access efficiency of irregular intersections is often much lower. Thus, it is very important to study traffic improvement measures to improve the traffic safety level as well as the traffic access efficiency of large intersections. To improve the increasingly prominent contradiction between supply and demand in large intersections as well as to reduce the number of traffic accidents, the outskirts of large intersections traffic design optimization is developed. At last, some of these methods are applied in an actual intersection to provide some reference for traffic designers.

1. Introduction
Large intersections are mostly caused by factors such as topography and road planning schemes. If these large intersections are not designed properly, it is easy to cause many traffic problems. On one hand, the distance that the motor vehicles, non-motor vehicles and pedestrians passing through the intersection would be longer, resulting in lower traffic efficiency at intersections as well as the confusion and conflict between the different modes of transportation, and the security of crossing the street is low.

Figure 1 An example of large intersection
2. Main ideas and measures for traffic improvement

The large intersection is a kind of plane intersection. The channelization measures for normal intersections are also applicable to large intersections. A reasonable channelization design method will have a multiplier effect. In order to improve the traffic problems of large intersections, we need to improve the design of the road space resources and time resources. The main ideas for improving the design are to reduce the intersection area, standardize the motor vehicle traffic track, and improve the efficiency of the intersection release. The main ideas are as follows:

2.1 Reduce the size of the intersection

To reduce the size of the intersection, we can set up islands at the intersection or at the corner of the intersection [1], shown in Figure 2 and Figure 3. Then the distance that the motor vehicles, non-motor vehicles and pedestrians passing through the intersection would be greatly reduced, which means the access efficiency of the intersection will be increased to some extent.

2.2 Regulate the trajectory of the vehicle

We can set traffic marking lines in the intersection to guide and regulate the vehicle's trajectory [2][3], shown in Figure 3. In this way, the vehicles would pass through the intersection in an orderly manner.
2.3 Improve the traffic efficiency
We can design some waiting-areas at the intersection, and the vehicles can move into the waiting-areas and wait for the signal to move on. In this way, we can make full use of the green signal time, and there would be more vehicles that can pass through the intersection in a signal cycle. However, the straight-forward vehicles and left-turn vehicles must be separated by setting different signals to ensure there are no conflict between them.

![Figure 4: Improve the traffic efficiency by setting waiting area](image)

3. Application of the improvement measures at an actual intersection

3.1. Current traffic characteristics
The intersection is very large, shown in Figure 5. A two-phase traffic signal is used at this intersection, however, the traffic flow is so large that it is common to see traffic conflicts between the straight-forward vehicles and left-turn vehicles. And there is no traffic markings to guide and regulate the driver’s, and the vehicle's driving track is seriously unsmooth. The most important is that the pedestrians must walk a long distance to cross the intersection, without any waiting-areas for them to stand and wait for the signal. In a word, the traffic efficiency of the intersection is not high, the traffic order is poor, and the traffic safety status is not optimistic.

![Figure 5: Current traffic characteristics at the intersection](image)
3.2. Improvement measures

The basic improvement design idea is to narrow the intersection area, reduce the conflict area, and clarify the amount of traffic rules and traffic rights of different modes of transportation. Specific measures are as follows:

- We can set up islands at the northeast corner and southwest corner of the intersection (using colored asphalt and flower pots [4]) to reduce the area of the intersection, and the efficiency of traffic can be improved to some extend.
- The radius of the edge of the northwest and southeast corners of the road should be reduced to about 10 meters, then we can set up pedestrian waiting-areas to shorten the distance of pedestrians across the street. Besides, it is important to carry out barrier-free slope reduction treatment at the end of pedestrian crossings to improve the safety and convenience of street crossing facilities.
- The green belts should be reduced to increase a right-turning lane to improve the evacuation efficiency of right-turning vehicles.
- We should adjust the traffic signal timing scheme and set the left-turn dedicated phase, then the conflicts will be greatly eliminated.
- The last but the most important is to clear the pedestrian crossing lines that are no longer used at the intersection and clarify the space for passage.

Specific measures are shown in Figure 6.

![Figure 6 Improvement measures at the intersection](image)

3.3 Expected effect

As shown in Figure 7, significant changes have taken place at the large intersection, as follows:

- The area of the intersection is greatly reduced and it seems to be a relative regular intersection by setting physical islands and traffic lines, and more vehicles can pass through during one signal cycle.
- We can set traffic marking lines in the intersection to regulate the vehicle's trajectory, then the vehicles can pass through the intersection in an orderly manner.
- Different traffic flows can run separately according to their own traffic signals and the
conflict points can be greatly reduced, then the traffic efficiency and safety level can be greatly improved.

- The pedestrians can walk through the intersection much safer and more convenient by setting waiting-areas.

![Figure 7 Expected effect of the improvement measures at the intersection](image)

4. Conclusions
Large intersections are often bottlenecks in road networks. The improvement of the traffic problems can play a vital role in alleviating the traffic congestion of the entire road network. The improvement methods of the large intersections are illustrated with an actual case, aiming to provide a certain reference for the traffic management departments and traffic design units.

Acknowledgement
Thanks for the sponsor of National Engineering Laboratory for Road Traffic Integrated Optimization and Safety Analysis Technologies, as well as the sponsor of Natural Science Foundation of China named “Theories and methods for traffic network design in transit-oriented multimodal evacuation (51578149)”.

References
[1] National standards “Road traffic signs and markings-Part3:Road traffic markings” (GB5768.3-2009)
[2] Yun Xia Wang. Common Issues on Standard Setting of Road Traffic Markings [J]. China Public Security Academy Edition, 2018 (1) : 66-69.
[3] Jin Gang Gu. Research on Non-Motor Vehicle Traffic Space Optimization at Signalized Intersections [J]. China Public Security Academy Edition, 2014 (4) : 79-83.
[4] Jun Jie Lu. Technology and application of coloured pavement [J]. Fujian Construction Science & Technology, 2013, (5) : 65-67.