Practical Application of Traffic Improvement Measures in Malformed Intersection

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Abstract. Deformed intersections are often caused by terrain, road planning and other factors, as well as their own geometric characteristics. The rate of accident at irregular 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 irregular intersections. Introduction

1. Introduction
Malformed intersections are mostly caused by factors such as topography and road planning schemes. Generally, the deformed intersections can be divided into multi-way malformed intersections and obliquely deformed intersections. The geometric nature of the deformed intersection itself often leads to an increased risk of traffic conflict.

2. Main ideas and measures for traffic improvement
The malformed intersection is a kind of plane intersection. The channelization measures for normal intersections are also applicable to the deformed intersections. A reasonable channelization design method will have a multiplier effect. The main ideas are as follows:
First, it is important to rationalize the intersection area and clarify the driving trajectory of the motor vehicle, by which the area of the conflict can be greatly reduced. Second, the traffic rules must be clear to ensure that different modes of traffic go smoothly without interference. Besides, the passage space of pedestrians and non-motor vehicles should be protected.

For malformed intersections, in general, a common improvement measure is to dictate the driving trajectory of a motor vehicle through traffic marking lines or to transform it into an orthogonal intersection or a misaligned intersection. Common methods are as follows:

2.1. Standardize the driving trajectory of motor vehicles
For large-area deformed intersections where a large part of the space is not utilized inside the intersection, a right-turning physical island or traffic marking lines may be set in the intersection. In this way, the unused portion is marked with a physical island or a marking lines [1], thus the driving trajectory of motor vehicles is regulated.

![Figure 2 Standardize the driving trajectory of motor vehicles](image)

2.2. Transform the deformed intersection into a relatively regular intersection
For intersections with large area, unclear driving trajectory and disordered driving order, such as some Y-shaped malformed intersections with small angles, reasonable channelization design should be implemented to change such intersections into relatively regular intersections [2].
2.3. **Convert the deformed intersection into a misplaced intersection**

For the oblique intersection, if there is enough road space, the secondary roads can be changed to two T-junctions, then the traffic rules can be clearly defined, and the safety level can be greatly improved.

3. **Application of design method at actual intersection**

3.1. **Current traffic characteristics**

The intersection is very large and malformed, but there is no traffic line to regulate the driver’s driving track, and there are no crosswalk lines to protect the pedestrians to cross the intersection. And most importantly, there is no signal light at the intersection, which means the traffic rules are not clear at all. As a result, the vehicle's driving track is seriously unsmooth and there are more than ten conflict points at the centre of the intersection, leading to high traffic accident rate, shown in Figure 4 and Figure 5.

![Figure 3 Transform the deformed intersection into a relatively regular intersection](image)

**Figure 3** Transform the deformed intersection into a relatively regular intersection

![Figure 4 Conflict points at the intersection](image)

**Figure 4** Conflict points at the intersection
3.2. Design 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:

- Physical islands can be used to fulfill the unused space at the intersection, in order to make the intersection to be a relatively regular and smaller intersection. Under these circumstances, these islands can provide waiting area for pedestrians to stand on waiting for the signal to walk through [3].
- Crosswalk lines should be properly designed which can ensure the safety and convenience of pedestrians crossing the street.
- A waiting area using colored pavement [4] should be set at the southeast corner of the intersection to make full use of the “white area” which is unused, then the safety of pedestrians can be improved to some extend.
- Traffic lights should be increased, then the different traffic flows can run through the intersection separately following their own traffic signal.
- Besides, yellow traffic markings are set at the intersection to regulate the traffic routes for left-turn vehicles.
- Traffic signs are also needed to provide traffic information for drivers and help them get to their destinations smoothly.

Specific measures are shown in Figure 6.
3.3 Expected effect
As shown in Figure 6, significant changes have taken place at the deformed intersection, as follows:
- The area of the intersection is greatly reduced, and it seems to be relative regular by setting physical islands and traffic lines.
- The pedestrians can walk through the intersection much safer and more convenient.
- 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.

4. Conclusions
Malformed intersections are often bottlenecks in road networks. The improvement of its traffic problems can play a vital role in alleviating the traffic congestion of the entire road network. The improvement method of the deformed intersection are illustrated with actual cases, aiming to provide a certain reference for the traffic management departments and traffic design units.

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References
[1] National standards “Road traffic signs and markings-Part3:Road traffic markings” (GB5768.3-2009)
[2] Xiao Guang YANG. Traffic Design [M]. Beijing: China Communications Press, 2010.
[3] Yun Xia WANG. Common Issues on Standard Setting of Road Traffic Markings [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.