

Analysis of Congestion Problems at Green Dream Roundabout Intersection in Yubei District

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Abstract: Traffic congestion can have a series of adverse effects: roads, highways, The traffic efficiency of highways and other transportation facilities is reduced, resulting in more serious traffic congestion; people's travel time becomes longer, a lot of time and energy are wasted, and daily work and life are affected; the risk of traffic accidents is increased, and the vehicles are dense when traffic congestion is dense, and traffic accidents are prone to occur; environmental pollution affects economic development; transportation costs are increased, and economic pressure is caused to enterprises and individuals, congestion has become a hot topic of discussion among the general public at present, especially in Chongqing, and solving traffic congestion is the urgent yearning of the people. Based on this background, this paper takes the traffic congestion at the intersection of Lvmeng Roundabout in Yubei District, Chongqing as the research object, and judges the traffic congestion level of the Lvmeng Roundabout intersection by referring to relevant domestic research articles and using intelligent traffic data to collect and analyze, and deeply analyzes the causes of traffic congestion at this intersection and gives a mitigation plan.

Keywords: Traffic Congestion; Yubei District; Chongqing; Intelligent Transportation Big Data; Roundabout.

1. Introduction

Intelligent transportation big data has a wide range of applications in the field of transportation. Hu Tao [1] and others analyzed the important application of big data in the field of intelligent transportation by studying intelligent transportation and big data. Sun Jiajun [2] and others explored the traffic congestion mitigation method based on big data and gave corresponding mitigation measures. Li Yan [3] analyzed the types of big data in traffic congestion and its important role around transportation big data. The study of Du Wei [4] gives the statistical data of typical congested roads in Yubei District, Chongqing and the assessment method of congestion level of related roads. Saturation as an important traffic parameter is widely used in academic research in the field of transportation. Zhao Qingqian [5] and others obtained a method for calculating the saturation of road sections and intersections by predicting the queue length as well as the traffic flow at intersections. Chen Weiya [6], Luo Zongyin [7] and others gave the calculation methods of queue length and the secondary queuing rate of intersections and their impact on traffic operation capacity, respectively. Li Yanmei [8], Xu Zhihong [9] and Zhumadian Daily commentator [10] gave specific solutions to alleviate traffic congestion in terms of improving the capacity of road sections, optimizing traffic organization and optimizing traffic order.

Due to the special geographical environment and climatic form of the mountain city of Chongqing, the transportation organization mode is quite different from that of the plain area. In this paper, this paper analyzes the current situation of congestion at the intersection of Lvmeng Roundabout, Yubei District, Chongqing, and uses the big data of intelligent transportation to analyze its congestion status, and gives its causes and mitigation measures, which can provide a reference for the integration of urban space and road planning.

2. Intelligent Transportation Big Data

2.1. Extensive Application of Big Data

Big data refers to the collection of data that cannot be captured, scanned, managed, and processed by common software tools in a certain period of time, and is the integration of data collections. Big data has a wide range of applications in intelligent traffic guidance, dealing with traffic problems, and traffic flow collection systems.

2.2. Characteristics of Big Data

Big data in traffic operation management has four significant characteristics:

- 1) Volume: The amount of data is huge.
- 2) Variety: There's a huge variety of data.
- 3) Velocity: Fast data processing speed.
- 4) Value: The data is of high value.

2.3. Apply Intelligent Transportation Big Data to Alleviate Traffic Congestion

1) With the help of intelligent transportation big data, urban traffic conditions can be analyzed, and urban road congestion information can be collected more macroscopically with cloud computing.

2) Mining the information elements of big data can summarize the development law of traffic big data, which is conducive to making good predictions for road planning.

3) Traffic big data plays an important role in key moments such as urban development planning, road administration development and management decision-making, and the accurate division and systematic analysis of congested road sections are inseparable from the reference and comparison of traffic big data.

3. Typical Roads with Traffic Jams

3.1. Introduction to Traffic Congestion

Existing criteria used to measure traffic congestion include V/C versus service level, queue length, average travel speed of motor vehicles on major roads, etc.

3.2. Introduction to Roundabouts

The roundabout is in the center of the intersection where several roads intersect, set up a round island or an island with an arc shape, so that all vehicles entering the intersection are driving around the roundabout in the counterclockwise direction, and its operation process is generally to converge (confluence) in different directions first, and then pass successively in the same lane (interweaving), and finally drive out in the same direction (diversion), which can avoid direct crossing, conflict and large-angle collision, and its essence is the self-regulating canalized traffic form. Its advantages are that the vehicle can continue to drive, safe, does not need management facilities, has a short average delay time, rarely brakes, stops, saves oil, and then has low noise and low pollution.

3.3. Introduction to the Intersection of Lumeng Roundabout

Based on traffic statistics, this paper analyzes the traffic congestion at the intersection of Lvmeng Roundabout, a typical congested road in Yubei District, Chongqing.



Figure 1. Location map of Lvmeng Roundabout intersection, Yubei District, Chongqing

The Lvmeng roundabout intersection is an intersection with roundabout and signal light control, which is located at the junction of Shuanglong Avenue, Qihang Road and Kaige Road in the Lianglu urban area, as shown in Figure 1 above. The community near the intersection is the settlement of the old Shuangcheng District, which is facing a large traffic legacy problem in the old urban area, such as chaotic traffic order and high traffic pressure, showing the normalization of traffic congestion. The congestion problem is as follows:

Affected by the great influence of bus trains, buses and queuing vehicles at intersections rush to drive.

The traffic order is chaotic and the road conditions are poor.

The traffic capacity of external nodes is insufficient.

The main arterial road nodes are dense, and the traffic continuity of the main road is affected.

4. Causes of Traffic Congestion

Table 1. Statistics of traffic congestion indicators at Green Dream Roundabout

Evaluation factors	Traffic congestion level				
	Severe congestion	Moderate congestion	Mild congestion	Basically unblocked	Smooth
Intersection traffic	5	5	10	5	5
Saturation	5	10	10	5	0
Average delays	5	10	5	5	5
Queue length	10	10	5	5	0
The secondary queuing rate of the signal port	15	10	5	0	0

From the above table, it can be concluded that the congestion level of the Laming roundabout intersection is light congestion. Based on the big data of intelligent transportation, the traffic congestion index of the intersection can be calculated by using the analytic hierarchy process algorithm, from which it can be obtained that the three indicators that have the greatest impact on the traffic operation of the Lumeng intersection in Yubei District, Chongqing are saturation, queuing length and the secondary queuing rate of the signal intersection.

4.1. The Influence of Saturation on the Ability of Traffic Operation

The section between intersections has a great impact on the traffic status of the intersection. The saturation of each entrance road is the maximum value of the saturation of the entrance lane in the entrance road, and the maximum value of the saturation of the entrance road in the four directions of the southeast and northwest is the saturation of the intersection. It is calculated as follows:

$$x = \max[x_A^E, X_A^W, X_A^S, X_A^N] \quad (1)$$

4.2. The Impact of Queue Length on Traffic Capacity

Traffic congestion will cause the collapse of network traffic and hinder traffic operation, so it is important to accurately assess the impact range of road traffic accidents and take effective rescue measures in time and restore normal traffic operation. According to traffic flow theory, queue length is an important parameter to measure the impact of traffic accidents.

4.3. The Influence of the Secondary Queuing Rate at the Intersection on the Traffic Capacity

Since the traffic can only pass within the effective green light time, if the number of vehicles N arriving in a certain cycle is greater than the maximum number of vehicles A that can pass in a cycle, then the last vehicles to arrive at $N-A$ cannot pass during the current period and a second queue occurs. Reducing the secondary queuing rate can effectively improve the traffic efficiency of the entrance road at the intersection and alleviate the road congestion.

5. Solutions to Alleviate Traffic Congestion

5.1. Enhance the Traffic Capacity of Major Road Junctions

The main road intersections around the intersection of Lumeng Roundabout in Yubei District, Chongqing are: Longsheng Street Intersection, Feihu Road Intersection, Yiwanshui Intersection, and Chengnan Interchange. By reducing green belts, increasing the number of lanes, and clearing parking spaces, we will improve the traffic capacity of the above-mentioned major road intersections and improve driving efficiency.

5.2. Improve the Traffic Capacity of Road Sections

Segment capacity refers to the ability of a road to be diverted under the same flow of traffic, also known as road capacity. Relevant data show that controlling the speed of vehicles in the road section can effectively improve the traffic capacity of the road section.

5.3. Optimization of Traffic Organization

According to the strategy, corresponding optimization measures should be formulated to adjust the traffic organization of some roads in the old urban area, such as: adjusting the unnamed branch road between Longping Street and Shuanglong Avenue to a one-way road, of which the two branch roads on the south side are adjusted from east to west, and the two branch roads on the north side are adjusted to be adjusted from west to east;

5.4. Optimization of Traffic Order

Optimizing urban traffic order requires the joint efforts of relevant departments and the people. Including new illegal parking capture, new relevant isolation facilities, new lane change capture, etc. to standardize the driving order.

6. Conclusion

The application of big data to the field of transportation can bring great convenience. Based on this, this paper takes the alleviation of traffic congestion as the starting point, takes the Lumeng roundabout intersection in Yubei District, Chongqing as an example, and analyzes the current situation

and causes of road traffic congestion based on intelligent traffic big data, so as to further put forward the management plan to alleviate traffic congestion from the aspects of traffic organization, traffic order, and road capacity.

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