

Optimization Strategy of Road Traffic System in Urban Renewal Area

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Abstract: At present, problems such as insufficient road infrastructure and supporting facilities, and limited parking spaces are increasingly prevalent, and there are large conflicts of interest in the process of urban renewal. Therefore, it is crucial to improve the quality of the road network. This paper presents an analysis on the current situation of the road traffic system in a completed area outside the Third Ring Road in Xindu District, Chengdu, and provides corresponding road traffic optimization strategies, with aims of solving the existing road traffic problems, improve road service levels, and promote the overall development of the area and improve the quality of urban space.

Keywords: Urban renewal; Road traffic system; Road network service

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1. Introduction

Under the background of the accelerating urbanization in China, urban renewal has become an inevitable trend of urban development, and the transformation brought about by urban renewal is a very important part of “organic renewal.” Urban renewal refers to the reuse and re-creation of urban space resources, which is an advanced stage of urban development. Since 2003, our country’s urbanization process has been accelerating, and major cities have formulated corresponding urban renewal plans and put them into practice. At present, our country’s economy is in a transition period from high-speed growth to high-quality development. Therefore, it is crucial to improve the urban space and the living environment of residents. In this context, many places in China have adopted the concept of “organic renewal” to renovate old urban areas and improve the quality of space. The road network, which is an important aspect of urban development, needs to be improved. The early research on road traffic system in our country mainly focused on road width, driving speed, and intersection setting; since the 1990s, scholars at home and abroad began to study the structure and design methods of road traffic system. Many scholars in our country have also proposed ideas for improving the traffic network in old urban areas under the background of urban renewal. Liu, et al. ^[1] conducted research on the problems in the old urban road network in the perspective of “organic renewal,” and proposed that it was useful for solving the current traffic problems in old cities. Yang ^[2] used the strengths, weaknesses, opportunities, and threats (SWOT) model to analyze the old city of Xi’an and had put forward suggestions for improvement. Wang et al. ^[3] carried out research on the traffic optimization of old urban areas based on “organic renewal,” and optimized the design of parking space, slow traffic system, and public transportation system. With the continuous urbanization of China and the increasing demand for a better living environment, the improvement of the overall urban spatial quality in the process of urban renewal needs to be emphasized. The main goal of road traffic planning and design is to improve

traffic efficiency and ensure travel safety. Yin ^[4] used analytic hierarchy process (AHP) to study the pedestrian road network system of historical and cultural districts in Guangzhou, evaluated its road design scheme and put forward relevant improvement suggestions. Qin ^[5] carried out 3D model construction and spatial analysis using 3D laser scanning technology and GIS method on the residential buildings and public spaces on both sides of Heping Street in Fengjing Town, Shanghai. Chen ^[6] used a combination of factor analysis and back propagation (BP) neural network method to study urban design of 179 neighborhoods in Huangpu District. After the analysis, it was proposed that the research on road capacity and traffic management should be strengthened in the reconstruction of the old urban area. Hu *et al.* ^[7] used a geographic information system (GIS) to analyze the characteristics of the road network in two districts of Tianjin and optimized the design. Huang *et al.* ^[8] conducted research on the road traffic status of Tuanjie Community, Zhan Road Street, Xicheng District, Beijing, and proposed measures to improve the internal traffic organization of the region, optimize the spatial layout of alleys, improve the pedestrian walkway system, and increase non-motor vehicles and barrier-free passages, and other measures that can improve the traffic capacity and environmental quality of the area. These research on the road traffic system is mostly concentrated on the theoretical aspects and lacks certain practical significance. Therefore, this paper will use road traffic system in a completed area outside the Third Ring Road in Xindu District, Chengdu as an example to discuss the corresponding optimization strategy through the analysis of its problems. Based on the background of urban renewal, it is of great significance to study the optimization of road traffic system. On one hand, the overall development of the region and the improvement of urban space quality can be promoted by improving the service level of the road network in and around the region; on the other hand, it can also as a reference for future urban renewal on the basis of existing theories.

2. Research overview

Xindu Street is located in the core area of Xindu District, which is a traffic-heavy location. The area of research, which is outside the Third Ring Road, is located on both sides of the central axis of Xindu Street, close to key development areas such as Xindu City, Hi-tech West District, and other key development areas. The buildings in the area are mainly multistorey residences, apartments, and residential mid-rise and high-rise buildings, which means that land use functions are mainly residential and commercial land. At the same time, there is an extension line of Metro Line 1 that was under construction in the area. According to the requirements of the Chengdu City Master Plan (2012–2030), Xindu Street is “an important space for the northward expansion of the central urban area,” and its function is defined as “a sub-center for northward vitality” and “a service center for city-industry integration.” The planning area extends to Huahua 3rd Road in the east, Xindu Road (Third Ring Road) in the west, Chengdu-Kunming Railway in the north, and Nanhe West Road in the south (under planning), totaling up to about 538 km² of land, and the planning area includes 10 communities and the Third People’s Hospital of Xindu District. The rail transit network in the region is also very developed, and there are subway lines 1, 7, and line 5 (under planning) in the surrounding area. The internal road network of the area is composed of north-south and east-west roads. The existing roads are mainly divided into three parts: north-south road, which is the Nanhe West-Xindu-Xingye road; east-west road, which is the Shulong-Jujin-Xingye-North Gaosheng road; an area outside the Third Ring Road has been built. Generally speaking, the current road network structure of a completed area outside the Third Ring Road is dominated by north-south roads, supplemented by east-west roads. Through on-site investigation of the main road sections in the area, it was found that there are mainly five types of traffic mode in the area: walking + public transport + slow lane (sidewalk + non-motorized vehicle lane), bus lane + non-motorized vehicle lane + sidewalk (occupy the road), pedestrian lanes + non-motor vehicle lanes (occupy the road), and intersections without traffic lights. Most of the intersections do not have traffic lights, and pedestrians show undesirable behaviors on the road. Besides, it was found that the road facilities in this

area are not perfect, where there are insufficient bus stations and parking spaces for non-motorized vehicles. Due to the high population density and amount business activities, the area is rich and diverse, and the crowd is relatively big. Therefore, the number of parking spaces is far from enough due to the growing parking demand, and it has been increasingly difficult to find parking. In addition, it was found that many bus stops only have one platform, which can only accommodate 1 to 2 buses. At the same time, there are many land plots in this area with relatively complete public facilities, but there is no dedicated bus line. Therefore, there are often long queues for buses and severe traffic congestion.

3. Analysis on the status and problems of the transportation system reconstruction in the urban renewal area

3.1. Poor road construction and traffic jam at transport hubs in some areas

The old city is lively, leading to problems such as road occupation, pedestrian and vehicles moving simultaneously on the road, and parking difficulties. Therefore, the development of road network has a great impact on traffic safety, efficiency, and order. The intersection is a “bottleneck” in the urban road transportation system, which is not only related to the comprehensive efficiency of the entire road network, but also a key link that affects the capacity of the regional road network. Because some intersections in this area have not been channelized and expanded, and traffic lights have not been optimally placed, the actual traffic flow is much smaller than the designed capacity.

3.2. Lack of sufficient parking spaces, occupying roads and public places

Due to the long history of the old urban area, problems such as urbanization, rapid increase in the number of cars, and insufficient supply of road traffic parking services were not fully recognized at the early stage of planning, resulting in parking facilities that could not meet the level of economic development in the area, which in turn caused serious traffic congestion at certain critical nodes and local segments in the area during peak hours.

3.3. Influence of rapidly developing motorization on low-speed transportation

Due to the development of our country and the continuous improvement of living standards per capita, the number of private cars of urban residents in China has increased rapidly. In road construction, excessive emphasis on cars is dominant. In the development of cities, the slow lanes are somewhat inferior, and the space for slow lanes has not been fully considered in the road planning. The urban rail transit and public transport system are not well-connected, which is mainly manifested in unideal urban spatial layout and insufficient facility capacity. In addition, the separation between the lanes for motorized vehicles and non-motorized vehicles is not obvious, the traffic signs and markings are not clear, the slow lanes are illegally occupied by pedestrians, and the traffic management is poor, which makes the slow lanes even narrower.

4. Reconstruction of road traffic system in urban renewal areas

The renewal of the road transportation system in the region should adopt the method of “embroidery.” According to the actual situation, corresponding countermeasures should be formulated to establish a road network system that is people-oriented and promotes microcirculation, so as to stimulate the vitality of the road network.

4.1. Comprehensive and optimal road network repair

4.1.1. Renovating the cross-section of the road

The sidewalks, non-motorized lanes, and motorized lanes (see **Figure 1**) should be well separated so that the roles of the lanes can be clearly defined. Damaged roadsides and sidewalks and subsiding pavement

should be repaired. The upstream and downstream pavement should be conditioned properly, and should be leveled and strengthened. In addition, the overall landscape and greenery should be coherent depending on the characteristics of the area.



Figure 1. Road streetscape and road function zoning map after updating and renovation

4.1.2. Optimization of node design to improve road network capacity

Taking the complex intersection of multiple traffic lines in the region as the main hub, the regional road network should form a supply and demand relationship, and the scheduling and design should be optimized.

4.1.3. Opening up dead ends to improve traffic network layout

Different renovation countermeasures should be taken for dead ends in the area depending on the causes, and detailed planning should be carried out to pen up the dead ends in the area.

4.2. Increasing parking spaces

4.2.1. Increase the inventory mining of the parking lot

In the case of meeting the parking needs of the community, without affecting vehicles and pedestrians, take corresponding countermeasures, and combine the roads conditions in the community, according to the living environment and parking needs in the community, flexibly set up roadside parking, which is mainly on secondary arterial roads and branch roads (see **Figure 2**), and the vehicle flow in the community should be reduced as far as possible, and the layout should be in parallel.



Figure 2. Schematic diagram of newly added parking spaces around the community after upgrading and renovation

The number of parking spots should be maximized; the layout of above-ground or underground public parking should be optimized, and idle land and public green spaces can be transformed into parking spaces with the consent of the residents and if the conditions permit without causing adverse consequences to the surrounding environment. The area of parking spaces at outdoor above-ground parking lots should be within 25–30 m²; the area of parking spaces should be within 30–40m² for indoor and underground parking lots ^[9].

4.2.2. Unified utilization and sharing of parking lots

Non-residential land such as commercial, office and public facilities can be utilized for parking lots. According to the public service project planned and constructed in the area, 20% of the new parking spaces will be free of charge, whereas 50% of the new parking spaces will be commercial parking spaces. The parking lot is not used as commercial land. The parking space and fee of the primary and secondary trunk roads are scientifically designed on the premise of ensuring traffic safety. The building functions should match the main public facilities and supplementary facilities. For residents of the old city, if there are no sufficient parking spaces, public parking spaces can be created around them; if there are no available spaces for parking lot construction, temporary parking spaces should be set up at the roadside. When economic conditions permit, commercial facilities in the area should be developed more parking lots should be created. To achieve complementarity, it is necessary to clarify the business objectives and scale of the parking lot. For example, on national statutory holidays, weekends, and evenings, the use of on-street parking and public parking facilities in the community will peak; during working hours on weekdays, the use of parking lots such as commercial centers and office buildings built in support of the community will peak.

4.3. Expansion to improve quality of slow lanes

4.3.1. Improving the connectivity between cities and expand the space for urban slow lanes

The public service facilities, station facilities, commercial service facilities and community service facilities in the region should be expanded. The non-motorized vehicles in the area have been reasonably planned to meet the individual and short-term needs for transportation for connection, transfer, and various leisure and entertainment activities. According to traffic demand, the “B + R” (bike + ride) transportation mode should be improved, non-motor vehicle parking spots should be strategically allocated in areas such as public transport stations, parks and green spaces, near public facilities, and on both sides of roads, so as to connect and enrich the “last mile” of the area, and to encourage the use of non-motorized vehicles, improve the radius and accessibility of public transportation services, and then increase the connectivity of public transportation.

4.3.2. Smooth slow traffic flow while preserving monuments

The historical and cultural features of the block and its original style should be retained throughout the renovation of the city. The traditional style and features of the region and the texture of traditional streets and alleys should be retained, while taking into account the regional environment, the proportion and scale of streets and alleys. The slow lanes on urban roads and the diversification and complexity of the land on both sides of the streets and alleys should be enhanced, and the main trail nodes should be connected ^[10,11].

5. Conclusion

In conclusion, the components of the road traffic system should be further optimized to meet the needs of residents and maintain the efficiency of the road traffic system. On the other hand, in the process of road network optimization, the long-term development of the roads should be fully considered, leaving room for further amendments of the road network structure in the township area.

Disclosure statement

The author declares no conflict of interest.

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