Thoughts on the Red Line Planning of Urban Intersections

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Abstract: Aiming at the controversies in red line planning of urban intersections under the new situation, this paper first clarifies the relationship between red line planning and intersection functional design. By analyzing the intersection design specifications, practices, trends and differences, the paper proposes the basic principles for red line planning at intersections in several aspects: transformation of development concept and design, coordination between the spatial certainty and functional uncertainty, and policy and system support. Based on the requirement from the new development concept and the characteristics of urban development, the paper presents the method of widening the intersection red line considering the boundary spacing of roadway network and for the red-line corner cut at intersections with different functionality types. Finally, the paper provides several thoughts on the red line planning of intersections in system structure and policies, methodologies, historic viewpoint, etc. **DOI:** 10.13813/j.cn11-5141/u.2019.0506-en

Keywords: roadway planning; intersections; red line planning; functional design; people-orientation; widened section; corner cut

0 Introduction

It was proposed to optimize the structure of urban road networks in the Opinions of the State Council of the Central Committee of the Communist Party of China on Further Strengthening Management of Urban Planning and Construction published in 2016. Since then, the urban road layout concept of "Narrow Roads and Dense Road Networks" (NRDRN) has resonated with every sector of society. As an important component of the urban road network, at-grade intersections become one of the hot topics. Some people believe that intersection space should be narrowed after the road network is densified, and red lines (road boundary lines) at intersections should be in the form of right angles, without segment widening or corner cut. However, some other people believe that red lines at intersections should be widened and corners should be cut based on the factors such as the aggravation of urban traffic congestion, the strong demand of right of way for pedestrian and bicycle traffic at intersections, and the emphasis and concern of traffic safety practitioners for traffic safety. These two contradictory viewpoints exist all the time, causing confusions in urban planners.

Many cities have been continuously studying and exploring red line planning at urban intersections. For example, the *Shanghai Technical Guideline for Regulatory Detailed Planning* was issued in 2016. In this guideline, it was proposed that under the premise of reducing road spacing and increasing road network density, red lines should not be widened at intersections, and they should be circular curves at intersection corners. The Chenggong District of Kunming City, Yunnan Province, China conducted some research and practice to narrow the intersection space. The same exploration was also conducted at the planning stage of Beijing Sub-center and Xiong'an New Area. However, the current *Code for Planning of Intersections on Urban Roads* (GB 50647-2011), hereinafter referred to as the "Code", is a mandatory code, and it requires red line widening and corner cut at urban intersections are facing the dilemma of lack of the technical basis for approval.

Therefore, it is necessary to summarize the requirements of red line planning at urban intersections, make suggestions for new times and new situations, and standardize the land use of intersections to reserve space for subsequent functional design.

1 Research subject and scope

According to the Code, the planning scope of an at-grade intersection shall include the area enclosed by the intersection of the roads, the approaching lanes, the departing lanes, and the road segments extending 10 to 20 meters outwards. The

Received: 2019-06-21

Supported by: Beijing Municipal Science and Technology Project (PXM2018_022217_000012)

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red line of urban intersections studied in this paper is the red line that defines the boundary of the planning scope described above. Intersection channelization, narrowing (Figure 1), traffic calming, pedestrian crossing, traffic islands, and safety islands are often mentioned in the literature. They are traffic design or traffic functional design, which are refined design within the red line.



Figure 1 Functional design of red line and intersection Source: Reference [2].

Urban red line planning at intersections reserves space for traffic functional design. Theoretically, to determine the red line of an urban intersection based on its functional design is the optimal strategy that can both serve the traffic functional demand and realize intensive land use. However, considering the preparation depth of the regulatory detailed planning, the continuity and uncertainty of planning and implementation, as well as the subsequent refined planning and design requirements of special urban areas, it is unnecessary and infeasible to carry out the traffic functional design within the entire urban area in the regulatory detailed planning stage. Therefore, it is difficult to determine the intersection red line based on the traffic functional design.

According to the Code, the red line should be determined through the traffic engineering planning, i.e., traffic functional design, for intersections of major arterials and intersections of major arterials and minor arterials with large traffic volumes. As for intersections of major arterials and minor arterials with small traffic volumes, intersections of minor arterials, and intersections of branches and roads of other levels, the red line should be determined according to the standardized method defined in the Code. However, due to the issues in the depth-matching and coordination of the regulatory detailed planning and the traffic engineering planning, the red line is often determined through the standard method in practice. In the subsequent design stage, the refined traffic functional design is then carried out within the boundary defined by the red line.

2 International experiences

2.1 Relevant regulations on red line widening at urban intersections

Reference [3] systematically summarized relevant regulations on the red line widening of urban intersections in China, which will not be covered in this paper. For overseas countries, the regulations of the U S, Germany, Japan, and some other countries are more representative, and they are all supported by a series of specifications for the refined planning and design of urban intersections (Figure 2). For example, A Policy on Geometric Design of Highways and Streets of the US proposed general principles of intersection design, which should be applied accordingly by the types of intersecting roads, such as local roads and branch roads ^[4]. The chapter of at-grade intersection design in the German Code for Road Design specified that the number of through lanes at intersections without signal control shall not be changed, and lanes for intersections with signal control shall be widened^[5]. The Road Structure Ordinance and Planning and Design of Intersection-Basic Edition [6] of Japan also mentioned the widening of approaching lanes at intersections.



Figure 2 Specifications on the red line of intersections in other countries

Source: References [4-6].

The relevant provisions on line widening at intersections in the standards have the following characteristics: 1) The driver's perception-response process studied in traffic engineering is combined with the practical experience to determine the lengths of the widened segment and the transition segment of an intersection and how much to widen. 2) The standards in China, represented by the Code, clearly proposed the widening of the red line at intersections. However, many overseas standards only mentioned the increase in the number of lanes at intersections without talking about the red line widening. 3) The Procedures for Planning and Design of Urban Road Intersections (DGJ 08-96-2013) issued by the Shanghai municipal transportation authority required the red line widening at intersections, with the length and width consistent with the Code. However, the Shanghai Technical Specifications for Detailed Regulatory Planning issued by the Shanghai planning and land and resources authorities encouraged the increase in road network density and proposed not to widen the red line at intersections in principle.

In addition, since London issued the *Urban Street Design Guide* in 2004 ^[8], Los Angeles, New York, Washington, Shanghai, Beijing, and other cities have also carried out the research and practice of street design guide to promote the return of humanized streets. These guidelines focus on the functional design of street space and conduct humanized and refined design of the public space outside the private space along the street.

2.2 Relevant regulations on red-line corner cut at urban intersections

There have been controversies about red-line corner cut at urban intersections. Some people believe that red-line corner cut is necessary from the perspective of providing enough sight distance to ensure traffic safety. For example, the Code requires that the red-line corner cut for the intersections of major arterials and minor arterials is generally from 20 to 25 meters, and it is 10 to 15 meters for branches. The local standards or technical specifications for most cities in China have similar specifications, but with varying sizes of corner cut. Some other people believe that red-line corner cut is unnecessary to meet the traffic operation demand at intersections ^[9].

This paper attempts to analyze the demand for red-line corner cut from the aspects of development history, behavior habits, and administration control. First, from the perspective of development history, some large overseas cities, such as New York, had highly developed road networks before motorization. After the transportation problems emerged due to the rapid development of motorization, they usually focused only on the traffic functional design and the optimization of time and space based on current road conditions. The right of way for pedestrians and bicycles at intersections was usually sacrificed in exchange for the turning needs of motorized traffic, considering the turning movements and the safe sight distance of motor vehicles (Figure 3a). However, with the strong demand for people-oriented travel, the urban street design guidelines of more and more cities emphasized narrowing the motorized space at intersections and using this space for the waiting and passage of pedestrians and cyclists (Figure 3b). From the perspective of the overall development process, the above-mentioned design is the traffic functional design or urban design in the space defined by the red line at intersections in accordance with the characteristics and needs of different historical periods.

Secondly, there are great differences in behavior habits and administration control methods at intersections between China's and overseas cities. Many overseas cities have stricter speed limit requirements at intersections than road segments. Speed limit applies even during the green phase at a signalized intersection. The speed limit value at intersections in some cities is about half of that on road segments, and off-site law enforcement and severe punishment measures are used to regulate driving behaviors and to decrease driving speeds. Through these measures, most drivers have formed relatively good behavior habits at intersections. However, the speed limits at intersections are not clear in most China's cities, and the behaviors of speeding up and rushing out at intersections have become a common problem. Therefore, in the current stage of urban development, the red-line corner cut at intersections is still needed for most China's cities to ensure the sight distance and safety.



a. Current intersection



b. Suggestions for optimizing traffic functional design

Figure 3 Functional design at intersections in different development periods Source: Reference [8].

 Table 1
 Specifications on red line or intersection lane widening

	Specification Re	ed line widening	Lane widening
National standard	Code for Planning of Intersections on Urban Roads (GB 50647-2011)		\checkmark
	Specification for Design of Intersections on Urban Roads (CJJ152-2010)		\checkmark
	Code for Design of Urban Road Engineering (CJJ 37-2016)		\checkmark
Local standard	Urban Road Space Planning and Design Specification (DB11 1116—2014)	n 🗸	\checkmark
	General Principles for Planning and Design of Construction Projects in Beijing	\checkmark	
	Chongqing Technical Specifications on Urban Planning and Management	\checkmark	
	Shanghai Technical Specifications for Detailed Regulatory Planning		\checkmark
	Procedures for Planning and Design of Urban Road Intersections (Shanghai)	\checkmark	\checkmark
	Wuhan Technical Specifications for Planning, Design Management of Urban Road Intersections	n and $$	
	A Policy on Geometric Design of Highways and Streets (the United States)		\checkmark
International standard	Code for Road Design (German)		\checkmark
	Road Structure Ordinance (Japan)		\checkmark

Source: Reference [7].

In addition, as the convergence points of pedestrian flows and bicycle flows in all directions, intersections are also potential public places for communication. For example, some overseas cities propose to compress the space for motorized traffic and use the saved space for public activities at intersections of residential streets (Figure 4).

3 Thoughts and methods of red line planning at intersections

3.1 Basic principles

3.1.1 Adhere to the transformation of the planning concept from car-oriented to people-oriented

The current planning and design specifications for urban intersections in China are mainly based on the car-oriented concept. Most of the specifications require red line widening and corner cut at intersections to reserve the space to laterally move the sidewalk, non-motorized lane, and roadside facility belt after motorized lanes are added. Although they ensure the passage space of pedestrians and bicycles, they also increase the crossing distance and time for pedestrians and cyclists due to the widening of motorized lanes. In practice, the traffic space for pedestrians and bicycles and the space for roadside facility belt are often narrowed to enlarge the number of motorized lanes at intersections. This phenomenon is particularly common in many overseas cities, given that their red lines are not widened and their corners are not cut at intersections. Some of the cities are now conducting street design to return the narrowed space to pedestrians and cyclists and to promote a people-oriented travel environment.

The mechanism of widening the red line at urban intersections in China is to ensure the traffic operation by increasing the area of intersections. After the founding of the People's Republic of China, influenced by the planning ideas of the Soviet Union, the big-community system was generally adopted. The area of the community was as large as 30 to 60 hectares. The roads inside the community did not allow external vehicles to pass through, and the roads outside the community were wide. Due to the lack of an internal microcirculation system of roads, it was necessary to enlarge the area of intersections to meet the distribution and turning needs of motorized traffic. However, in the new era, the central government has issued policies to promote the open block system. A series of national standards have been published, such as Standard for Urban Comprehensive Transport System Planning (GB/T 51328-2018) (hereinafter referred to as the "Standard") and Standard for Urban Residential Area Planning and Design (GB 50180-2018). These standards all suggest increasing the density of the road network, reducing the average distance between roads, and decreasing the concentration and complexity level of traffic flows at intersections by enlarging the road density to form a homogeneous distribution and operation roadway system.



a. Corner convenience store



b. Corner leisure place

Figure 4 Public space design at the corner of intersection in Paris, France Source: Photos by GUO Jing.

3.1.2 Adhere to transformation of intersection design concept from engineering design to functional design

According to the new development concept, intersection design should break the traditional approach of traffic design, which focuses on engineering structure design and motorized functional design and transform to people-oriented traffic functional design. Intersection design should also strengthen the space demand of pedestrians, bicycles, and public traffic in the intersection area and ensure its continuity, convenience, and comfortability. In the current transition from expansion to optimization, it is advisable to reform the function and improve the quality of road transportation in conjunction with city betterment and ecological restoration. The red line planning at intersections should follow the principle of safety first, giving priority to the waiting, turning, and passing of pedestrians and cyclists. Then drivers' needs to pass through the intersection smoothly and orderly should be considered, for example, adding more lanes at intersections of arterials and coordinating traffic signals.

3.1.3 Adhere to coordination of spatial certainty and functional uncertainty

The coordinated development of transportation and land use has always been the goal of urban planning. Both road traffic space and land use space have clear boundaries and are certain to some extent, but reasonable functional layouts and uses have great uncertainty. This kind of uncertainty is particularly serious under the current situation of optimizing existing resources. The travel demand and behaviors will change significantly with the reorganization of production function, the reconstruction of life function, the renewal and upgrade of industries, and the optimization and adjustment of urban form and urban function. Therefore, the coordination of transportation and land use is dynamic. The red line planning at intersections should adapt to such dynamics and uncertainties, use land intensively, but also reserve the necessary space resources for the operation of intersections.

3.1.4 Adhere to support of policy and administration mechanism

The land for road use is usually allocated land, and the administration authorities are generally the government transportation departments of all levels or their entrusted enterprises. However, the building setback space is generally owned by the owners of the buildings along the street. Due to the inconsistency of administration right and land ownership, it is difficult to integrate the planning of the space between the curb and the red line and the building setback space. In the process of urban development from extensive planning to refined planning, urban design has been put on the agenda. In the meantime, the integrated planning and design of the space outside the curb at intersections and the building setback space urgently need the coordination and breakthrough of the policy and administration mechanism.

3.2 Red line widening at intersections

3.2.1 Principles of red line widening

Considering both the central government's requirement of NRDRN and the Standard, it is encouraged to optimize and densify the urban road network to achieve orderly operation of traffic flow, reduce the concentration and complexity level of passenger flow at urban intersections, lower the demand for space to distribute passenger flow, and thus decrease the size of the land at intersections. When the road network is dense enough in a region, it is permitted for the red line at intersections not to be widened, and flexible traffic operation plans can be adopted to achieve orderly operation of traffic flow. However, the central urban areas in many cities in China are built-up areas. Due to the influence of the big-community culture, it is difficult for the road network in these areas to meet the requirements of the dense network in terms of network density and average spacing. Therefore, it is still necessary for these areas to increase the space at intersections to achieve the orderly distribution and operation of passenger flows in various directions. However, different policies should be applied according to the location of the area. Old urban areas should focus on protection and take into account the transportation needs. The red line for urban intersections outside the old urban area should be widened appropriately, and similar rules could be applied to the intersections inside a town. The decision flowchart for red line widening is shown in Figure 5.





3.2.2 Red line widening for closely spaced intersections

When the average spacing of the road network in a region does not exceed the spacing threshold, the intersections in the road network are considered as closely spaced intersections and this road network is considered as a dense network. As for the determination of the spacing threshold, the Standard requires that the road network density for the central urban area should not be less than 8 km km⁻², which implies an average spacing of 250 meters. The requirements for the size of street blocks with different functions are also listed in the Standard. In general, each side of a residential street block

should be shorter than 300 meters; the side of a commercial street block or a street block with concentrated employment should be 100 to 200 meters long; any side of an industrial or logistics park street block should not be longer than 600 meters. According to Shanghai Technical Guideline for Regulatory Detailed Planning, the average spacing of roads should not exceed 150 meters in the central area of public activity, which should not exceed 200 meters in the residential area. The road network densities for urban central areas of Tokyo, Paris, Seoul, and some other cities are all above 10 km km⁻², corresponding to an average spacing less than 200 meters. In addition, the threshold value for the widened segments (including the transition part) of two adjacent intersections to overlap can be calculated, and this value can be used as the spacing threshold for not widening the red line. For different levels of roads, the maximum spacing thresholds are all about 200 meters. When the spacing is less than 200 meters, the widened segments of two adjacent intersections would overlap. Therefore, the red line is widened over the entire road segment between the two adjacent intersections in the context of a dense road network, which violates the concept and intention of NRDRN.

Based on the above analysis, it is suggested to use the average spacing of 200 meters as the threshold for determining the dense road network. When the average spacing in the road network does not exceed 200 meters in a region (usually enclosed by arterials or higher level of roads), the intersections in this region are regarded as closely spaced intersections, and their red lines should not be widened.

3.2.3 Red line widening for normal urban road intersections

Intersections in the road network with the average road spacing more than 200 meters are defined as normal intersections in this paper. Red line widening at these intersections should be considered to meet the traffic operation and urban development needs in the built-up areas of many cities. The factors to be considered for red line widening include, but are not limited to, what is shown in Table 2. In general, the consideration of these factors should focus on the passage and distribution of pedestrians, non-motor vehicles, and motor vehicles. Other influential factors, such as additional space demand, should be considered separately.

 Table 2
 Influential factors on red line widening at intersections

Туре	Influential factor		
Surface	Sidewalk, non-motor vehicle lane, vehicle lane; median strip, barrier to separate motor vehicles and non-motor vehicles, roadside facility belt; bus stop, rail transit station entrance and exit and auxiliary facilities, on-street parking, newspaper kiosk, bridge pier; lighting pole, manhole, municipal facilities such as power supply and communication facilities		
Underground	Metro line, rail transit station; engineering pipeline, comprehensive pipe gallery, etc.		
Along the road	Functional coordination of transportation and land use, coordination of landscape, scenery protection, etc.		

Source: Reference [7].

The following principles shall be followed for the widening of the red line at intersections: 1) The width of the non-motorized lane within the intersection area shall not be less than the effective width of the non-motorized lane on the basic road segment. 2) The width of the sidewalk within the intersection area shall not be less than that of the sidewalk on the basic road segment. 3) The sidewalk trees within the intersection area shall be planted in a transparent manner to avoid influencing drivers' sight distance, and they shall maintain a certain degree of continuity. 4) On the premise of meeting the above principles, the demand to enlarge the number of motor lanes should be met by reducing the width of motor lanes and that of other facility belts, such as the median strip.

When the red line of the basic road segment is wide enough, the above principles can be met even without widening the red line at intersections. According to the road cross-section elements and corresponding dimensions specified in the Beijing local standard *Urban Road Space Planning and Design Specification* (DB11/1116—2014) (CPDURS), the above requirements can be met even without widening the red line at intersections when the red line width of the basic road segment is no less than 50 meters on major arterials, no less than 45 meters on minor arterials, and no less than 30 meters on branches.

When the red line width of the basic road segment is less than 50 meters on major arterials, less than 45 meters on minor arterials, or less than 30 meters on branches, the red line needs to be widened at intersections to meet the above principles and the requirements about cross section elements and corresponding dimensions specified in the Beijing local standard. As for how much the red line should be widened, the practice of *General Principles for Planning and Design of Construction Projects in Beijing* issued in 2003 should be followed. In the regulatory detailed planning stage, the red lines on both sides should be expanded symmetrically, each side being expanded by five meters on major and minor arterials and by three meters on branches.

In addition, when the width of the red line for a branch road is no more than 20 meters, this road's living and communication function should be fully considered, and its motorization function should be weakened. In principle, the red line for this kind of intersection shall not be widened.

3.2.4 Red line widening for intersections under special circumstances

The red line widening for intersections under special circumstances should be treated differently. For example, in a cultural relic protection area of an old city, the intersection red line should be planned by following the cultural relic protection requirements, with the consideration of urban forms, layouts of transportation facility, travel characteristics, etc.

3.2.5 Treatment of rail transit stations, bus stops, and other transportation facilities at intersections

Most urban rail transit stations in China are located at road intersections. According to Urban Rail Transit Network Planning Standard (GB/T 50546-2018), the main body of the station should be located within the road red line, and the auxiliary facilities should be located in the adjacent land plots outside the road red line. However, for rail transit stations that have been built, some auxiliary facilities encroach upon the road red line (Figure 6a). It is advisable to conduct necessary assessments. If the auxiliary facilities of the station, such as entrances and exits, ventilation pavilions, cooling towers, and management rooms, affect the safe passage of pedestrians, non-motor vehicles, and motor vehicles (Figure 6b), necessary improvement measures should be taken. When there are renovation and reconstruction projects in the surrounding area, the auxiliary facilities should be integrated into the surrounding buildings.

As for bus lines and bus stops within the intersection, the space for platforms and bus lanes should be prospectively reserved in accordance with relevant standards in new areas. While in built-up areas, necessary assessment and refined functional design should be conducted to meet the demands of various traffic flows for safe and orderly operation and transferring and satisfy the sight distance and convenience requirements.

3.3 Intersection red-line corner cut

As for corner cut of the red line at urban intersections, different methods should be applied by the intersection types. Intersections can be classified into two types: traffic-oriented and living-oriented intersections (Figure 7).

For traffic-oriented intersections, the priority is to ensure the safety and mobility of the traffic. Many studies have shown that it is a common phenomenon for conflicting traffic



Figure 7 Corner cut at intersections

flows to accelerate and rush into the intersection during the transition of signal phases. Although this is a problem of traffic management, it indeed reflects the common driving behaviors and driving habits. Since the relevant laws, regulations, rules, and control facilities are not completely ready yet, the corner cut for this type of intersections should still be retained in the current stage. However, the size of the corner cut could be reduced through measures of speed limit. For some overseas cities, although the requirements of the intersection sight triangle are not clearly defined, strict speed limit management and law enforcement measures are in place. It is required that vehicles need to slow down to about 50% in advance when they are approaching an uncontrolled intersection even if there are no conflicting vehicle movements at the intersection, which ensures the sight distance requirement through limiting the speed. Meanwhile, cities also have great differences in the development process of motorization and urbanization. Therefore, the actual current needs of the cities in China should be seriously considered for red-line corner cut at intersections.



a. Entrance and exit of station are in intersection sight triangle

b. Ventilation pavilion of station encroaching upon the sidewalk

Figure 6 Relationship between metro station and red line at intersections

For living-oriented intersections, the priority lies in the living, communication, and service functions. As a place to distribute people flows in all directions, this type of intersections provides potential space for public activities. Some overseas cities start the attempt to arrange some microbusinesses or micro-centers at intersection corners of livingoriented streets to serve the public along the street and improve the convenience of public service. Therefore, it is suggested that the red-line corner cut should also be retained for this type of intersections, but the emphasis should be placed on micro-squares, public activities, convenient service outlets (Figure 4), etc.

In addition, intersections also need a certain amount of corner cut space due to the factors such as turning of non-motor vehicles and motor vehicles, waiting of pedestrians and non-motor vehicles, municipal pipelines, and landscape greening.

In summary, it is suggested to keep the red-line corner cut at urban intersections, but the size of the corner cut can be reduced by limiting the speed of motorized traffic. The priority of the red-line corner cut at traffic-oriented intersections is to ensure traffic safety and mobility, and the size of the corner cut should be 15 to 20 meters. The priority of the red-line corner cut at living-oriented intersections is the living and service functions, which should be designed based on the land use along the street with the size of the corner cut being 10 to 15 meters.

3.4 Practical applications of red line planning at intersections

During the planning of Beijing Sub-Center, the practice of NRDRN was implemented. The density of the road network was increased. The average spacing of intersections was reduced, and flexible one-way traffic operation was implemented in some areas to achieve the distribution of traffic flow through NRDRN. The red line was not widened at intersections, and the size of the corner cut was reduced to 10 to 15 meters. At present, the traffic at these intersections is in healthy condition. However, this new attempt was faced with the problem of lack of regulation basis in the approval process, because all the requirements in the Code have to be followed and the Code requires the red line widening and corner cut at intersections. It is suggested that relevant codes and standards for red line planning at intersections should be revised and improved as soon as possible based on the new policy requirements.

4 Several thoughts

1) Debate of car-oriented and people-oriented concepts

Both widening and corner cut of the red line at urban intersections are to reserve space for traffic functional design, which can serve not only cars but also pedestrians and cyclists. In some overseas cities, the process of motorization is later than the process of urbanization. When motorization arrived, the road space for pedestrians and cyclists had been sacrificed to facilitate motorization. While in the current period, the sacrificed space is returned to pedestrians and cyclists under the requirement of the people-oriented development. Therefore, the widening and corner cut of the red line at urban intersections should not be the focus of the debate on the car-oriented and people-oriented concepts. In the current stage, traffic functional design and urban design should be strengthened. Communication and public service functions should be enhanced, and the transformation from a street with single mobility function to a street that is dynamic and vibrant should be promoted.

2) Dialectical thinking of historical viewpoint and development reality

China has experienced the stage of rapid urbanization, which is now undergoing the transformation from expansion to optimization. Most of the broad roads are the products of many influential factors, such as the Soviet Union's planning mode and rapid motorization and urbanization. They are also closely related to the lane mode and layout. In the new era, the new development concept should be implemented, and the development practice of the built-up area should be considered as well. For example, the big-community culture is deeply rooted in Beijing. The density of the planned road network in the central urban area of Beijing is about 7 km km⁻². It is difficult to optimize and densify the road network, and it is even more difficult to open the big community. Only about 30% of the planned minor arterials and branches have attained planning criteria. Therefore, it is still necessary to rely on major arterials to collect and distribute traffic flows, which is a common problem faced by many cities in China. In such cases, the practice of red line widening and corner cut should be retained to meet the needs of urban development.

3) Support of administration system and mechanism

The Ministry of Housing and Urban-Rural Development of China and some cities have initiated the formulation of administration measures and relevant guidelines on urban design, in order to enhance the administration of urban planning and construction, shape the features of a city, and improve the level of urban construction. However, compared with urban design, traffic functional design has been lacking corresponding administration mechanism and supporting standards. Some cities such as Shanghai, Shenzhen, and Hangzhou have conducted research and practice on traffic functional design, which however is not continuous, dynamic, or systematic. In the context of development with existing resources, many cities have begun the exploration to reform the function and improve the quality of urban transportation, which is a great opportunity but also a big challenge.

5 Conclusions

Urban red line planning at intersections reserves space for

traffic functional design. For a long time, traffic functional design is defective in its mechanism, which is dominated by car-oriented and engineering-based concepts. Under the call of people-oriented development in the new era, the red line planning at intersections is facing many doubts and controversies. Based on the requirement of NRDRN, as well as the current situations of urban and traffic development, this paper proposes ideas, approaches, and some thoughts on red line widening and corner cut at intersections. The following topics will be studied in the future: the planning and practice of the red lines at intersections in old urban areas, towns and villages; the revision and improvement of relevant guidelines on red line planning at intersections based on the characteristics of development stages and research practices of cities; the policy mechanism and specifications for the integrated planning and design of the space outside curbs and the space within building setback lines.

Acknowledgements

I am grateful to LIU Bin, GAI Chunying, BIAN Yang, LAN Yajing, XU Lin, GUO Jing, DUAN Hongzhi, GAO Chao and others in the preparation team of the Beijing local standard *Technical Regulations for Red Line Widening and Corner Cut at Urban Road Intersections* for their support to this research.

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(Translated by ZHOU SE)