

Key Points and Scheme Comparison of Urban Expressway Traffic Design

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Abstract: As the main link connecting the city, suburbs and industrial parks, the expressway must meet the needs of inter-city expressway transportation on the one hand, and play a role in supporting the normal operation of the city on the other hand. This paper firstly analyzes the main characteristics of China's urban expressways according to the current research situation, and proposes three key points for the design of China's urban expressway traffic system. The two methods are compared and selected, which proves the rationality of the design focus of China's urban expressway traffic system. The thesis proposes that in the overall design process, various factors such as the characteristics and scale of urban highways, urban geographical environment and social and economic development trends should be taken into account to ensure that the overall planning and design of highways meet the actual requirements of the city, and provide the basis for future highway construction projects. It provides a solid foundation for the smooth development.

Keywords: Urban Expressway, Traffic Design, Design Points, Scheme Comparison and Selection

1. Introduction

Transportation capacity is one of the decisive factors of regional development benefits, which helps to change the regional spatial structure. China has built a highway network as an important way to promote economic growth.

2. Research Status of Urban Expressway Traffic

Transportation capacity is one of the decisive factors of regional development benefits, which helps to change the regional spatial structure. China has built a highway network as an important way to promote economic growth. At present, the transportation network covering the whole country is under construction, and new lines are gradually established [1]. Urban expressway mainly refers to the ordinary expressway within the scope of large and medium-sized cities in China. This type of expressway is an important part of China's expressway network. However, in recent years, due to the acceleration of China's urbanization process, urban traffic has become chaotic, and urban traffic entrance and exit congestion has led to poor traffic. Some urban high-speed traffic projects can not bear the heavy burden of urban traffic, so the reasonable design of expressway has become an important link of urban economic development and the key point of urban social development [2].

Expressway network plays an important role in the process of economic and social integration of large and medium-sized cities. It directly changes the spatial network generated by traditional roads and promotes the shortening of inter regional and cross-border distances [3]. Most studies show that the causal relationship between the development of high-speed transportation and economic progress is stronger than previously thought. Before the 21st century, there was little research on Expressway in China, but with the continuous construction of expressway, many scientists began to pay attention to the development of Expressway and achieved some research results. The construction management department and highway design department have made a number of highway design research results on the basis of integrating foreign advanced concepts and technologies and combined with China's reality, but they are not enough in the rating index system of highway route planning. When selecting the optimal route model at the highway construction site, there are fewer quantitative indicators, more qualitative indicators, and no systematic and perfect indicators to evaluate the route model. The problem is complex and there is no systematic analysis. The evaluation indicators and results are

insufficient and can not fully reflect the rationality and complexity of the plan. There are some disadvantages. Although the research object and scope are still very limited compared with foreign countries, it proves the value of urban expressway network research to a certain extent [4].

3. Characteristics of Urban Expressway

3.1. Relieve Traffic Pressure

In the process of high-speed urbanization in China, the scale of high-speed road network in large and medium-sized cities is expanding day by day. At the same time, the requirements for comprehensive transportation hub and short-distance high-speed intercity rail transit are also gradually improving. However, due to the shortage of land in some cities, some cities are unable to build new high-speed roads to reduce congestion. On this basis, it can be found that expressway is the main channel to reduce urban traffic congestion [5].

3.2. Closure

For the main roads in the urban section, in order to prevent the horizontal obstruction on the pavement caused by the mixed flow with the urban traffic, the highway has strict requirements on the number of motor vehicles in the design process, and adopts the scheme of full interchange and full closure to effectively isolate the highway from the environment, so as to strictly control the entry of livestock and pedestrians and ensure the normal operation of all equipment on the highway [6].

4. Highway Traffic Design Elements

4.1. Construction Conditions

In the whole process of urban highway design, we should first comprehensively analyze the actual situation of urban highway. If the terrain of the project area is open and flat and there are houses along the road, the overall layout of the project road can be designed flexibly. In the design process, we must pay attention not to occupy houses, cultivated land and other places, and fully consider the horizontal connection between pedestrians and vehicles [7]. In the process of highway construction, we should also fully consider the relationship between stations, and reasonably and safely adjust the scale of toll stations, so as to avoid unreasonable highway wiring. In short, when designing the urban expressway project, the designer must manage the relationship between the project and the surrounding buildings, the relationship between the project and the landscape, and the relationship between the project and the buildings to be built. Only in this way can the project coexist harmoniously with roads, communities, buildings, railways, subways, etc.

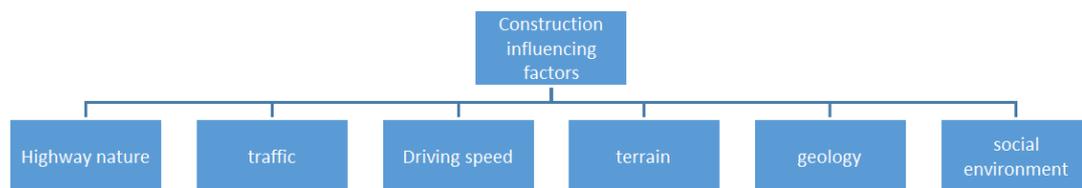


Figure 1: Influencing factors of Expressway Construction

4.2. Planning Points

In the conceptual design stage of urban highway project, the designer shall report the planning point to the planning office in advance, and adjust the coordinates of the planning center line, the width of the route and the slope of the project itself. In the plane design of highway engineering projects, it is very important to reasonably plan the coordinates of the road centerline. Generally speaking, in the map, in addition to the planning centerline, it is also necessary to design logical planning according to the intersection of the route project [8]. In this process, the corresponding pavement indicators shall comply with the corresponding specific provisions, maintain the continuity between the pavement, and

reasonably avoid including the landform and terrain of buildings in the project construction area. How to use avoidance to reasonably reduce the demolition area, so as to reduce the cost of urban construction, should be reflected in the architectural design, that is, the reflection of the main ability in the architectural design of urban planning highway. In addition to the above planning requirements, the horizontal and vertical aggregation of urban sections must also be fully considered. According to the relevant regulations issued by China, the requirements of horizontal and vertical combination must comply with the provisions of high-speed lane, but for low-speed lane, there is no mandatory provision when the construction site cannot meet these requirements.

4.3. Environmental Protection Concept

In the process of urban expressway design, designers should adhere to the four principles of safety, durability, environmental protection and low carbon. First of all, the principle of safety is that the design of the project will inevitably be affected by the terrain, and there may be many buildings on the construction site. The designer should first ensure the safety of engineering design and construction, and also ensure pedestrian safety as much as possible, so as to integrate the safety concept into the whole design of the highway [9]. The so-called durability principle refers to the permanence of the pavement. Designers should also fully consider the anti teratogenicity, anti fatigue performance and anti geological disease scheme. The principle of environmental protection means that when designing a highway project, the designer should also protect water and soil and reduce construction noise, so as to maintain good soil and plants in the project construction area. The new expressway will have a certain impact on the environment. The impact on the natural ecological environment along the expressway is mainly reflected in the water and soil loss caused by excessive land use and industrial production, the destruction of the ecological effect environment of animals and plants, the land occupation of the project, the destruction of the landscape and surface vegetation along the expressway [10]. In the design process, measures must be taken to reduce the damage to vegetation and protect the natural environment. In the process of expressway design and construction, due to traffic noise, road closure and other reasons, it will have an irreversible impact on the natural ecology, which should be carefully analyzed and deeply discussed during the planning and design [11]. At the same time, noise also has a significant impact on the living environment. Especially during the construction period, the noise from the operation of personnel and construction machinery will have a great impact on scenic spots, public facilities, residential areas and factories. The design also needs to take into account the protection of residents' daily life. Finally, in the process of project design, the principles of low-carbon, longitudinal slope optimization, saving and emission reduction should also be considered, which has laid a solid foundation for improving the environmental friendliness of the project.

4.4. Economic Indicators

The economic evaluation of engineering project is not only an integral part and important content of expressway project feasibility study or evaluation, but also the main basis for selecting urban expressway road design. The design of urban expressway needs to grasp the economic indicators and consider the financial situation of the local government, the total project cost and operation and maintenance cost.

4.4.1. Total Project Cost

The total cost of highway engineering construction is referred to as the total cost of the project, which is usually composed of engineering cost, equipment and tooling cost, deployment cost, interest during construction, etc. [12]. The construction cost will directly affect the follow-up operation of the expressway project. How to improve the direct economic benefits of Expressway and promote the sustainable development of regional economy is one of the most important issues to be considered in the comparison and selection of expressway design. The design of urban expressway will directly improve the level of urban economic development and promote people's living standards. Therefore, the design process needs to be comprehensively evaluated in combination with short-term and long-term interests.

4.4.2. Operating Costs

Operating costs mainly include maintenance costs, energy consumption and management costs during operation. The operation of urban expressway will inevitably affect the management of areas along the line, such as acoustic environment, construction kilometers, hydrogeological conditions, etc. [13]. The length of the line is the main factor affecting the project cost. Longer schemes will increase

operating costs. Therefore, it is necessary to compare and analyze the route plans in the design process. How to save the operation cost as much as possible while meeting the above factors is a key problem that cannot be avoided in the design process.

5. Traffic Design Scheme of Urban Expressway -- Taking the Expressway Construction in Manzhouli City as an Example

Taking the expressway construction project of Manzhouli City as an example, Manzhouli City is the key development and opening-up pilot area in China; An important comprehensive hub in Eurasia; At the same time, it is also the core city of the experimental belt for the development and opening up of China's northern border, the bridgehead for the opening and development of Inner Mongolia's border to Russia and Mongolia, and the leader of the economic development belt of border ports [14]; It is Hulunbuir and its regional central city, extending and radiating to the cross-border areas adjacent to Russia and Mongolia. According to the overall construction plan, it is determined as the overall idea of "port driven, axial development, industrial city integration and radiation area", forming a banded "t" spatial structure of "two axes, two cities and eight clusters". Manzhouli urban section is proposed to adopt the existing Haiman class I Highway Corridor. The scheme selection should fully consider the overall urban planning of Manzhouli and reasonably reserve interchanges to create favorable conditions for urban development [15].



Figure 2: Manzhouli urban planning map

New construction scheme (line k): under actual conditions, a new line will be built on the north side of chapenar toll station to avoid the planning area near chapenar planning area and Manzhouli East Interchange, route along the planned north outer ring road, and connect with the existing road at the North Ring Road of Manzhouli City. Chainage range: k1514 + 599.080-k1536 + 234.903, with a total length of 21.636km. Advantages of the plan: ① avoid areas conducive to urban development; ② In line with the overall urban planning of Manzhouli City, it is conducive to expanding the urban framework, which is consistent with the direction of the north outer ring road; ③ Conducive to the traffic conditions in the east of Manzhouli; ④ It is conducive to regional road network planning, realize the traffic conversion with border roads, and consolidate national defense; ⑤ Erka port, Donghu District and other places are very convenient to get on and off the expressway quickly. The disadvantage of this scheme is that it occupies more new land.

Reconstruction scheme (line a): close the existing Haiman class I highway into an expressway, set a separate interchange to cross the crossed Road, and build a new auxiliary road to connect chapannor and Manzhouli. Mileage range of main line: ak1514 + 599.080-ak1537 + 820, with a total length of 23.221km. Mileage range of auxiliary road: fdk0 + 000-fdk11 + 755.165, with a total length of 11.755km. Advantages of the plan: ① using the existing Hyman class I highway, only some sections are raised in the longitudinal plane, and the new land occupation is less; ① It does not conform to the overall planning and traffic planning of chappenor, which is not conducive to the development of vehicles passing through chappenor; ② Class I highway is closed, which is not conducive to the travel

of villagers along the line. ③ The construction period of the bridge is long, causing interference to residents during construction; ④ Not supported by local governments.

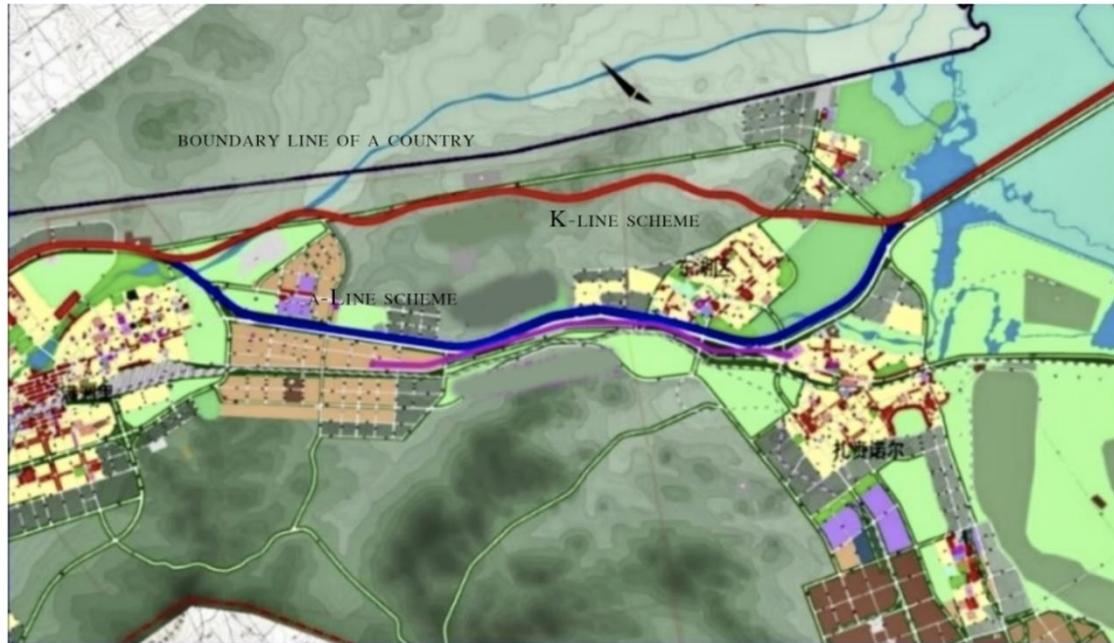


Fig. 3: Scheme comparison

According to the key points of urban expressway design mentioned above, the new construction scheme of line k is more in line with the traffic design of urban expressway. Therefore, line k is also selected in practice, as show in table 1.

Table 1: Comparison and selection of technical and economic indicators of schemes

project	Company	Scheme K line	Line a scheme
Origin destination station		K1514+599.08~ K1536+234.903	AK1514+599.08~ AK1537+820
Route length	km	21.636	23.221
Minimum radius of horizontal curve	m	1100/1	960/1
Maximum longitudinal slope	%	4	-3.45
Subgrade Earthwork (filling/excavation)	10000 m3	178.625/78.312	131.482/55.145
pavement	Thousand M2	385.755	597.440(Including auxiliary road 82.284)
Protective drainage masonry	Thousand M3	40.084	24.597(Including auxiliary road 0.456)
Bridge	M/set	480/1	3030/7
Separation interchange	M/set	260/4	360/1
Passage	Avenue	3	/
Culvert	Avenue	19	20(Including auxiliary road)
Land acquisition	Mu	1413.85	272.33
Construction and installation fee + land acquisition	Ten thousand yuan	73518	67217
Recommendation		recommend	

6. Conclusion

Expressway is an important economic artery of a country. Therefore, when considering the conflict of objectives, the most suitable route scheme should be selected as far as possible. In addition, economic and social impacts need to be considered. In road design, road design is an important link to achieve the goal of road construction, which will have a significant impact on the whole project and all

aspects along the line. To sum up, combined with the current overall design of urban roads in China, this paper proposes that in the process of urban road project planning, designers should start with the project environment, adhere to the principles of safety and sustainability, and continue the design process of environmental protection and low-carbon. In principle, the project is coordinated with surrounding buildings, agricultural land and other facilities to further reflect the people-oriented development concept. At the same time, strengthen the construction of expressway network and road expansion in these areas to cover densely populated areas and meet the development needs of these areas. On the other hand, strengthen support for the rear area to ensure that the rear area and national roads can connect important cities. This has laid a solid foundation for the operation of expressway network projects in the future. Urban expressway not only effectively alleviates urban traffic, but also contributes to long-term social stability. In addition, taking the expressway construction in Manzhouli City as an example, this paper proves the key points of urban expressway traffic design, and explains that expressway design needs to provide better services for the local economy. As an important support for regional development, expressway should be combined with regional economic development, use the construction and opening of Expressway to realize reasonable layout, and vigorously promote the development of local industrial production, tourism and other important industries. Meanwhile, urban expressways need to strengthen efficient communication with high-speed rail, ports and other transportation. While building a comprehensive transportation system, give full play to the comparative advantages of different transportation modes, connect different transportation modes with high quality, fill the gap and improve transportation efficiency. On the other hand, while the industrial layout of highways, high-speed railways and other industries promotes the refinement of industries, promote the coordinated development of urban centers and optimize the spatial layout of economic activities.

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