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Municipal Road Reconstruction Practice in the Context of Urban Renewal: Taking Mount Taishan Road Reconstruction in Yantai as an Example

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Abstract: With the renewal of the city, the function of internal roads in the old urban area is not only limited to ensuring the basic travel of residents, but also supporting the renewal of blocks along the road, the axis of urban image display, and the support for public services and leisure and recreation of residents. However, there are prominent issues such as insufficient road capacity, poor slow traffic travel environment, and outdated overall facilities in the internal roads of the old urban areas. Based on this, this article takes the reconstruction of a typical urban trunk road in an old urban area as a case study. Firstly, it analyzes the existing problems of the road situation, proposes the reconstruction goals of improving travel quality, improving road landscape, and enhancing street vitality. Secondly, it elaborates the road reconstruction plan in detail from the aspects of cross-section reconstruction, slow traffic system reconstruction, public transportation system reconstruction, intersection reconstruction, parking system reconstruction. Finally summarizes the design highlights of the project and the problems encountered in design and solutions. The purpose of this article is to explore solutions for improving the transportation environment and comprehensive renovation of the street environment in the context of urban renewal, promoting urban renewal in old urban areas through road renovation, and providing reference for similar projects in the future.

1. Introduction

In the context of urban renewal, the cause of comprehensive road reconstruction is not only to solve urban traffic problems, but also to take this opportunity to improve the urban environment and stimulate urban vitality. The comprehensive renovation of urban trunk roads is a shortcut to rapidly improve the quality of urban environment. It can not only avoid the huge investment and the defects of long construction period caused by large-scale new construction, but also revitalize the old city, so that more public traffic can be gathered along the road interface, and upgrade the road to a public activity corridor that can reflect cultural traditions and regional characteristics. The authors in [1-2] did some meaningful researches on methods and theories of road renovation in the context of urban

renewal, the authors in [3-9] shared engineering cases and experience of road renovation combining with local characteristics, and the authors in [10-12] have made valuable explorations in the renovation of old urban areas, especially in landscape design.

Yantai Economic and Technological Development Zone has experienced nearly 40 years of history since its establishment in 1984. The eastern area of the development zone is the regional center of the whole development zone. Mount Taishan Road is an important urban trunk road in the eastern area of the development zone, starting from Haibin Road in the north and ending at Shenyang Haikou Expressway in the south. It is generally north-south, with a length of about 4.3km and a design speed of 60km/h.

The nature of land use around Mount Taishan Road in the south and north is quite different. To the north of the Pearl River Road, the land is mainly used for commerce and residence, and the intersection of Mount Taishan Road and Changjiang Road is a large shopping mall; To the south of the Pearl River Road, the land is mainly for industry, and the current situation is mainly for manufacturing plants.

According to the urban planning, Mount Taishan Road is an important "one vertical" in the "five horizontal and five vertical" road network in the east of the development zone, and also an important corridor for public transportation. The northern section of Mount Taishan Road is planned to be the area with the highest regional development intensity. At the intersection of Changjiang Road and Mount Taishan Road, a municipal commercial center is planned. At the same time, residential land will be increased in the southern section. The surrounding area of Mount Taishan Road is also a key area for the development zone to implement urban renewal.

The roads in old urban areas often have prominent problems in various aspects, comprehensive road reconstruction requires consideration of multiple factors, and the design work is cumbersome and challenging. However, a successful implementation of the renovation can greatly improve the travel environment, stimulate urban vitality, and enhance the well-being of citizens, it is of great significance to effectively promote urban renewal.

2. Analysis of Current Problems and Reconstruction Objectives

2.1. Analysis of Current Problems

Insufficient road traffic capacity and serious congestion at morning and evening peak time of key nodes. As an important north-south trunk road, Mount Taishan Road is mainly responsible for medium and long distance travel in the region. Due to the large intensity of surrounding land use and traffic demand, the one-way two lane traffic capacity before reconstruction is insufficient, and some sections are congested in the morning and evening peak. The channelization expansion and traffic conversion of intersections were not fully considered, resulting in serious congestion of some important roads and core conversion nodes, mainly concentrated in the intersection of major roads in the area, such as the intersection of Yangtze Road, Yellow River Road and the Pearl River Road; At the same time, around the business district, the traffic flow is obvious, and it is difficult to ease the traffic at peak hours.

Slow traffic has poor travel environment and prominent safety hazards. Before the reconstruction of Mount Taishan Road, 18 pedestrian crossing facilities are set up along the whole line, with an average spacing of 238m. In addition to the pedestrian crossing at the intersection through the light control signal light, there are 6 sections of pedestrian crossing. In addition, there is no central guardrail in all sections of Mount Taishan Road except Desheng Shopping Mall and the section to the east of Friendship Square, where pedestrians cross the road at random in non-pedestrian crosswalk areas, which has prominent potential safety hazards and affects the traffic order of motor vehicles. In the area around the school where there is a strong demand for slow-moving street

crossing, it is necessary to set up special personnel to be on duty during the peak hours of students' going to and from school, to guide the traffic and maintain order.

The overall facilities are old and lack of facilities for smart city construction. Lighting street lights, traffic signs, bus stops, trash cans and other supporting facilities are old, and electric boxes and newspaper kiosks are set on the sidewalk, seriously affecting the traffic space. Most sections of Mount Taishan Road are lined with shops, and the front area of the building is a chaotic parking space, lacking public rest places. Before the reconstruction, the variety of road greening plants was single, the proportion of evergreen tree species was relatively large, lack of flowering shrubs, and lack of seasonal changes and colors in the road plant landscape. Unable to install relevant facilities and equipment required for smart city construction.

2.2. Reconstruction Objectives

Improve road capacity and travel quality. As a key area for urban renewal, the surrounding area of Mount Taishan Road will induce more traffic demand, and urban renewal needs the support of traffic facilities. At the same time, the intersecting roads have been implemented or planned to implement reconstruction projects, which will further increase the traffic pressure of Mount Taishan Road after the improvement of traffic capacity. Therefore, it is urgent to improve the traffic capacity of roads and focus on the slow traffic travel experience.

Improve the road landscape and the city image. The north end of Mount Taishan Road extends to the golden beach coast, which is a famous tourist attraction in Yantai city. Build a harmonious and unified landscape style through road reconstruction, focusing on the image of the city from point to area and taking the road as the axis.

Comprehensive improvement of the environment along the street to enhance the vitality of the street. As a typical lifestyle trunk road, Mount Taishan Road is an important carrier for citizens to travel. With road reconstruction as the starting point, the road will drive and improve the reconstruction of infrastructure along the line, promote the improvement of the surrounding environment, thereby enhancing the vitality of the street, and ultimately promote urban renewal.

3. Road Reconstruction Measures

3.1. Road Section Reconstruction

Before reconstruction, Mount Taishan Road is a three lane road, and the specific section layout is 5m pedestrian walkway+6m non-motorized lane+1m motorway and non-motorized lane+14m motorway+1m motorway and non-motorized lane+6m non-motorized lane+5m pedestrian walkway=38m, as shown in Figure 1. The two-way four-lane traffic capacity of the motor vehicle lane is insufficient, and the non-motor vehicle lanes on both sides are too wide, which is inconsistent with the travel characteristics of the low proportion of local non-motor vehicle travel, and there is the problem that motor vehicles occupy the non-motor vehicle lane at will.

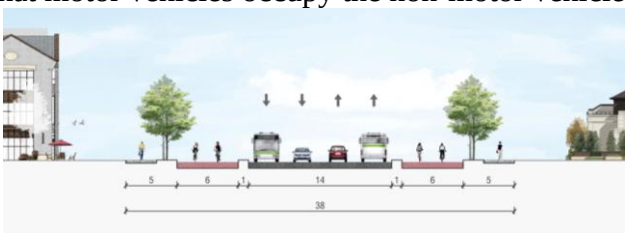

Figure 1: Standard cross section of road before reconstruction

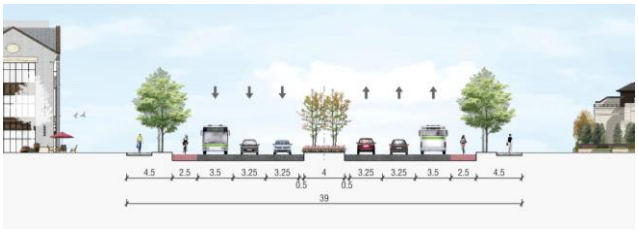

Figure 2: Standard cross section of road after reconstruction

After reconstruction, Mount Taishan Road is in the form of two roads, and the specific section layout is 4.5m pedestrian path+2.5m non-motorized lane+10.5m motorized lane+4m central separator+10.5m motorized lane+2.5m non-motorized lane+4.5m pedestrian path=39m, as shown in Figure 2.

The newly added central green separation belt after reconstruction will change the street scale, reconstruct the street view space, and re-form the street scale and avenue space suitable for the core area of the old city. At the same time, the central separation space can be used at the intersection to set up left-turn lanes and pedestrian secondary crossing areas. According to the traffic demand forecast, the motor vehicle lane will be transformed into two-way six-lane, and the width of non-motor vehicle lane will be reduced at the same time. Under the condition of meeting the traffic demand of non-motor vehicles, the problem of vehicles occupying non-motor vehicle lane at will for a long time will be avoided. The width of the pedestrian walkway is 4.5m, and the green facility belt is set on the side near the non-motorized vehicle lane. The pedestrian passage space and the front area of the building are designed in combination to expand the pedestrian activity space.

In the road reconstruction, the front area of the building is also included in the unified reconstruction scope to realize the integration and overall consideration of the space inside and outside the road, expand the pedestrian distribution space, set landscape nodes in some areas, and set parking spaces in some areas to alleviate the parking pressure around.

3.2. Transformation of Slow-moving System

The green facility belt of the pedestrian path creates a comfortable slow-moving space, and improves the pleasure of slow-moving leisure in combination with multiple landscape nodes set in the front area of the building.

For the slow crossing of the road section, sort out the crossing position of the current road section, re-analyze the pedestrian crossing position of the road section in combination with the nature of the surrounding land, the location of the opening, the location of the bus stop, etc., and add the self-help signal light for crossing the street, give priority to ensuring the safety of slow crossing, and improve the traffic efficiency of motor vehicles when there is no slow crossing. For slow crossing at intersections, traffic diversion islands and secondary crossing safety islands are added to shorten the primary crossing distance and improve the safety of pedestrian crossing.

For schools and other areas with strong demand for crossing the street, an underground passage will be added to meet the needs of students to go to and from school to cross the street and create a safer and more comfortable way to go to school. For the core area of the business district, three-dimensional street crossing can be realized through the non-payment area of the rail transit station in the future.

3.3. Transformation of Public Transport System

At present, there are 7 pairs of bus stops in Mount Taishan Road. The distance between some stops in the north section is only 250m, and some sections in the south section are short of bus stops.

All stops are set on the road section, and are not combined with pedestrian crossing, so it is inconvenient for pedestrians to cross the street when arriving and leaving the stop. The bus stops are in the direct stop mode, which seriously affects the road capacity when the bus stops.

The road reconstruction plan rearranges the position of the bus stops, adjusts the position of the bus stops in combination with the setting position of the pedestrian crossing the street, realizes the passengers to cross the street from the rear of the bus after getting off, and enhances the safety of the pedestrian crossing the street. At the same time, bus bays are added along the whole line to reduce the impact of bus stops on road traffic efficiency, and the form of non-motor vehicle back-wound is adopted to realize the zero weaving of non-motor vehicles and buses and ensure the safety of non-motor vehicles.

3.4. Transformation of Intersections

There are 12 intersections along Mount Taishan Road, including 4 intersections with trunk roads, 3 intersections with secondary trunk roads, and 5 intersections with branch roads. The starting point at the south end of Mount Taishan Road and Shenyang Haikou Expressway remain in the form of right in and right out, while the north end of Taishan Road and Haibin Road remain in the form of roundabout, and the intersection with the main and secondary trunk roads is still in the form of signal light control. Based on the traffic demand analysis, the traffic organization form of the two intersections was partially optimized, and the T-intersection of Mount Taishan Road, Yihe Road and Xiangjiang Road (branch road) was adjusted from the original signal light control to the right in and right out form.

By analyzing the traffic characteristics of each intersection, the channelized widening design is carried out to improve the traffic capacity of the intersection. According to the traffic demand, the left turn lane is increased by compressing part of the central separation strip to ensure the independence of the left turn signal control at the intersection and reduce the flow line conflict at the intersection; In combination with the space in the front area of the building, add right-turn lanes and traffic diversion islands to enable right-turn vehicles to drive out of the intersection in advance; At the same time, at 50m in front of the intersection, an early turn-off is set to reduce traffic conflicts and alleviate the interference and conflict between the second crossing and the vehicles turning around. Figure 3 shows the reconstruction plan of Mount Taishan Road and the Pearl River Road.

Figure 3: The reconstruction plan of Mount Taishan Road and the Pearl River Road

3.5. Parking System Optimization

Parking difficulty in the old city is a common problem at present. For the parking system, the design will first sort out the parking demand and parking supply of the whole line, and use the front area of the building to add parking spaces for areas with parking gaps.

According to the specification requirements, different parking strategies are determined according to the width of the whole building area: for the area with the width of the front area of the building greater than 11m, vertical parking mode is adopted; For areas with a width of less than 11m and more than 7.4m in the front area of the building, the inclined parking mode is adopted, and the angle is adjusted according to the width of the front area of the building; For areas with a width of less than 7.4m and more than 6.2m in front of the building, parallel parking mode shall be adopted; For areas with a width of less than 6.2m in the front of the building, no parking space is set for landscaping. At the same time, analyze the entrance and exit of each parking space, and define the parking traffic organization flow line.

4. Design Highlights

4.1. Complete Street Concept

In the face of the limited space of the current road, the renovation is carried out according to the concept of building an integrated block space, and the space in front of the building and the building facade are integrated into the plan for comprehensive consideration. The renovation scope of the road breaks through the control of the red line, realizes the construction of the urban road landscape in blocks, and integrates the space bearing the road with the space bearing the surrounding plots.

The road design starts from the traffic and activity needs of people, takes the traffic system organization as the core, and realizes the coordination between the traffic system and the land use function, and the coordination between the traffic and the ecological environment through the spatial overall design. The front area of the building shall be arranged uniformly to solve the actual problems of local elevation difference and drainage. Parking space shall be set in the sections with conditions and short parking space, and the small space shall be used for greening landscape design. According to the surrounding land use, in hospitals, schools, residential areas and other sections, from the perspective of supplementing and improving the function and image of public activity places, use the space outside the red line to add street micro-parks, increase the public and open urban space node system, provide public rest gathering space, and enrich the experience of travellers.

4.2. Landscape Integration

The road landscape design is no longer just street trees and hedges. This time, the landscape design will run through all stages and majors. The landscape design takes "one road, two sections, and multiple points" as the overall structure, and takes the golden leaves as the unified keynote. The "red movement" in the north section of the road uses the red and pink flowering plants to display a warm business atmosphere. The "blue and purple symphony" in the south section of the road uses the blue and purple flowering plants, reflecting the warm, romantic and comfortable atmosphere, as shown in Figure 4. Combining the surrounding land use situation, multiple nodes are created in important areas along the road, significantly improving the landscape effect compared to before the renovation, as shown in Figure 5. At the same time, the landscape specialty participates in the determination of the pavement style of the pedestrian walkway and the front area of the building, and in the modeling design of urban furniture such as smart light poles, bus stops, seats, garbage

cans, and car stop piles, to ensure that the style of the road is unified everywhere and the effect is harmonious.

Figure 4: Road landscape rendering (north section and south section)

Figure 5: Comparison of road nodes before and after reconstruction

4.3. Refined Design

Before the reconstruction, many poles, such as traffic poles, lighting facilities, monitoring facilities, etc., are set on the pedestrian walkway. This design adopts the method of integrated intelligent lighting poles, replacing the poles with different functions with integrated poles, and minimizing the number of poles. In addition, there are some large distribution boxes in the former pedestrian walkways, resulting in many obstacles to the pedestrian space. This design combs the distribution facilities of the whole line, moves the distribution boxes that occupy the pedestrian space, optimizes the design of the facade materials, and then uses greening to eliminate the hidden. Invisible manhole covers are uniformly used for pedestrian walkways to improve the comfort of the slow-moving space. And create conditions for the installation of relevant facilities and equipment required for the construction of a smart city.

In the design, conditions are reserved for the long-term project. Considering the construction of the long-term subway station, reasonable positions are still reserved for the station entrance and exit, wind pavilion, etc. at the road widening.

In the whole design process, the historical memory of the citizens is especially retained. In order to preserve the sculptures bearing the memory of the local people at the intersection of Changjiang Road and Mount Taishan Road, it is specially designed to ensure that the sculptures are not moved or removed by narrowing the lane width, reducing the turning radius and other ways during the intersection design. The white poplar outside the factory building in the industrial zone has grown for decades. The original design plan was to remove the tall white poplar, and then consider that the tall tree crown carries the good memory of the factory workers. Therefore, the plan was specially modified to retain these tall poplar trees, while adding landscape design, taking the white poplar as the background and matching plants of different heights to form a hierarchical planting effect.

5. Summary

In the process of road reconstruction, due to the early construction time of roads and insufficient width reservation, it is difficult to implement in some areas. The construction management department has made great efforts to coordinate the land use issues such as the widening of the intersection and the widening of the bus stops, and has adjusted the road design for the places where the land acquisition and demolition are difficult to ensure the transformation effect. Due to the problem of the ownership of the facility poles, we failed to integrate all the facility poles.

Road reconstruction is the key content in the process of urban renewal. Through road reconstruction, it can effectively alleviate the traffic congestion, induce the orderly development of the city, enhance the vitality of local areas of the city, reconstruct the landscape of the whole city, and highlight the image and characteristics of the city. At the same time, through the excavation and collation of the history and culture of the roads, it can effectively retain the city's imprint, highlight the cultural heritage, and ultimately promote urban renewal.

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