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Original Paper

Research on the Design Scheme of Xingci Eighth Road Expressway

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Abstract

This paper takes the Xingci Eighth Road project as an example, based on the project's planning and current status, combined with traffic volume forecasting and current situation analysis, through comprehensive scheme comparison and selection, the most reasonable scheme is selected from multiple aspects such as scheme feasibility, traffic function, and economy.

Keywords

Tunnel, Expressway, Overall design

1. Introduction

The connection between the expressway network and the urban rail network and various districts in Ningbo requires the improvement of the external transportation system within the region. The external road network includes highways, urban expressways, and regional main roads, strengthening the connection between Hangzhou Bay New Area and Yuci area, and constructing multiple expressway networks between the new city and Yuci area; Strengthen the connection between Hangzhou Bay New Area and ports and airports, and build a fast link with the central city of Ningbo. Connect the expressway network system between Yuci and the central city of Ningbo, forming a "two horizontal and two vertical" expressway network ("two horizontal" refers to Shiyitang Avenue and Binhai 1st Road; "two vertical" refers to Ciba Road and Xingci Avenue), ensuring that there are at least two expressways connecting each major direction.

After the completion of the "two horizontal and two vertical" expressway network, the east-west connection is convenient, providing strong road support for the land layout of "west living, east

production", making the separated functional group development model possible, and also providing convenient channels for freight transportation, promoting the strategic goal of separating passenger and freight transportation to be achieved.

2. Engineering Overview

The planned red line width for the Xingci Eighth Expressway (Jinci Road Binhai Fifth Road) project is 50m, with a design speed of 80km/h for the main line and 50km/h for the auxiliary roads on both sides. The road is planned to have two circular curves with radii of 1450m and 4000m along the entire route. The road starts from the north side of Jinci Road in the south, intersects with Haicang Road, Binhai Second Road, Binhai Fourth Road in the north, and ends at Binhai Fifth Road in the north. The total length of the road is about 2.4km.

3. Construction Background

The Hangzhou Bay New Area is located in the northern part of Cixi City, with the Shuiyunpu River to the east, Qitang Highway to the south, the western boundary of the wetland protection area to the west, and the boundary of the Hangzhou Bay sea area to the north. The land area is about 235 square kilometers and the sea area is about 350 square kilometers.

The spatial structure of Hangzhou Bay New Area is "two belts, three axes, and three zones". The "two belts" refer to the public service belt and the ecological leisure belt. The "three axes" refer to the three functional axes formed by relying on the main ecological landscape resources. The land use in Hangzhou Bay New Area presents a clear clustered layout, with three functional clusters: wetland leisure area, business new urban area, and smart industry area, arranged along an axis.

4. Overall Program

4.1 Design Principles

This project is based on the urban economic development and overall planning of Qianwan New Area in Ningbo, and the urban transportation planning, striving to propose a practical and feasible engineering design scheme that meets the needs of urban transportation development. The design principles of this project are as follows:

(1) The design scheme is conducive to leveraging the traffic function of the road, facilitating the distribution and evacuation of urban traffic, balancing road network flow, improving the overall operational efficiency of the road network, and promoting the development and coordination of regional planning.

(2) Fully pay attention to environmental and landscape requirements, focus on cultural landscapes and greening, and create a good driving environment and urban landscape effect.

(3) From the perspective of traffic safety, improve pedestrian crossing facilities and simultaneously construct engineering facilities that are convenient for disabled, elderly, and visually impaired groups.

(4) The construction standards are in line with the functional positioning, striving for consistency throughout the entire line.

(5) Adhere to the principle of "function first", make reasonable use of existing road facilities, and reduce abandoned projects.

(6) Reasonably arrange bus routes and station planning, set up horizontal pedestrian passages, and arrange non motorized vehicle passages along the route.

4.2 Overall Design

The overall design scheme has undergone multiple rounds of scheme demonstration in the early stage and has been approved by the planning department. In principle, no major modifications will be made, and each section can be fine tuned according to the actual situation.

According to the latest adjustment plan, the overall plan has made the following adjustments in the feasibility study plan: (1) Reserve T-shaped interchange conditions on the east side of Binhai Avenue, and combine the north and south ramps; (2) Optimize some ramp settings based on the distance between ramp entrances and exits and the form of connection with highways. The adjusted plan is as follows: Xingci Eighth Expressway connects to G228 Expressway in the south, and adopts elevated continuous crossing over Zhongxing First Road, Binhai Avenue (with T-shaped interchange), Binhai First Road, and Batang Hengjiang before landing. A ground section of about 200m is set up, with two tunnels respectively passing through Haicang Road, Binhai Second Road, and Binhai Fourth Road (in the form of a ground expressway between the two tunnels). After the tunnel exits the ground, it connects to Shitang Hengjiang Bridge, starts from the south side of Binhai Sixth Road and crosses Binhai Sixth Road and Binhai Seventh Road continuously before landing. A ground section is set up, ending at the interface of the highway toll station on the north side of Yuhai East Road. There are a total of 8 pairs of parallel ramps/entrances/exits along the route.

(2) Overall Plan for Section I of Phase I Project

The first phase of the project, Section I, starts from the north side of Jinci Road in the south and ends at Binhai Fifth Road in the north, with a total length of about 2.4km. Based on the overall plan of the entire section, the following three comparative options are proposed for the scope of this design:

Option 1: A ground expressway section is set up at the starting point of the plan to connect with the south elevated landing section. Then, a tunnel (with a total length of 1070m and a buried section of 635m) is used to pass under Haicang Road and Binhai Second Road before exiting the ground. Another ground expressway section is set up, and another tunnel (with a total length of 760m and a buried section of 270m) is used to pass under Binhai Fourth Road before exiting the ground and connecting with the north side cross Shitang Hengjiang Bridge.

Option 2: A ground expressway section will be set up at the starting point of the plan to connect with the elevated landing section on the south side. Then, a tunnel (with a total length of 2190m and a buried section length of 1755m) will be used to pass under Haicang Road, Binhai Second Road, and Binhai Fourth Road before exiting the ground. The endpoint will be connected to the north side of the Shitang

Hengjiang Bridge.

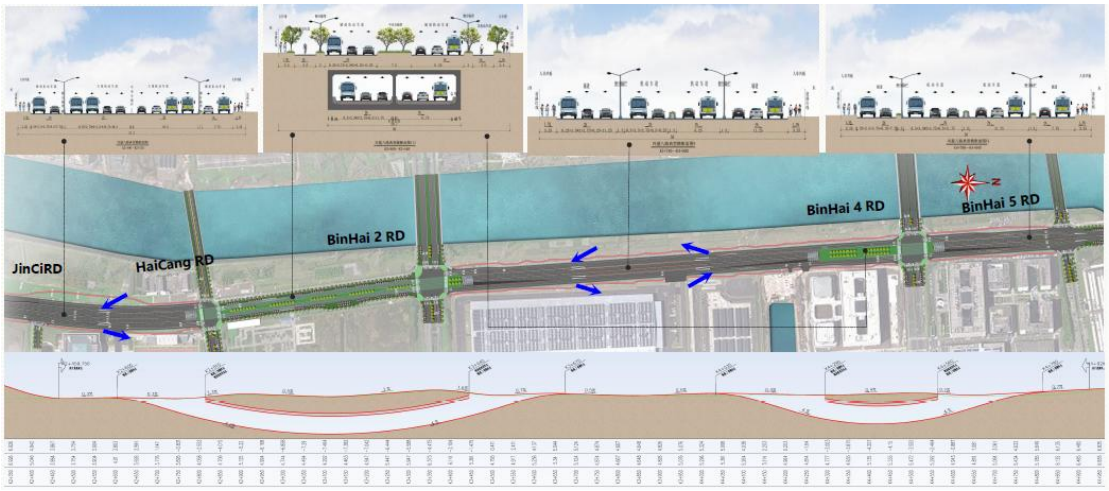

Figure 4-1 Overall Layout of Scheme One: "Middle Tunnel"+"Short Tunnel" Scheme

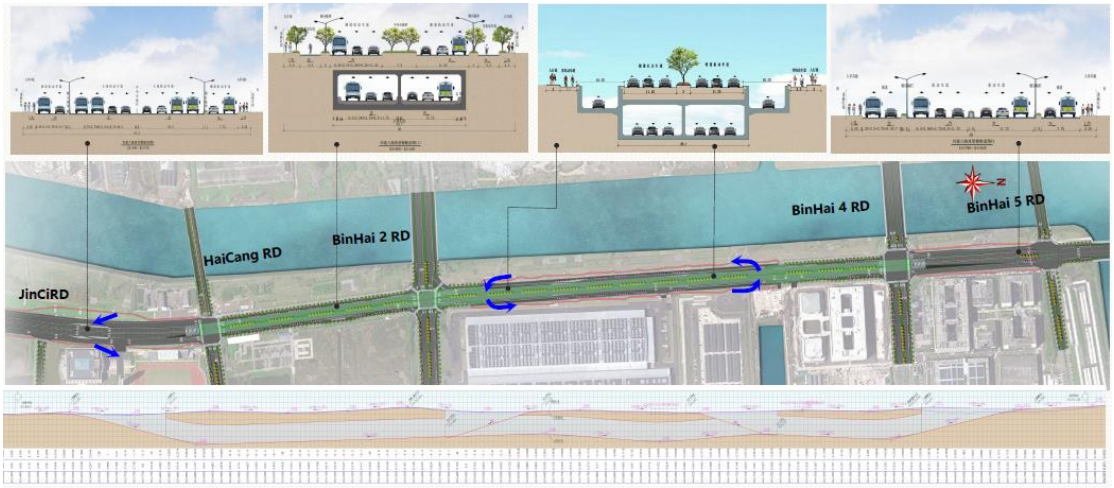

Figure 4-2 Overall layout of the "Long Tunnel" scheme in Scheme 2

Option 3: The starting point of the plan continues the elevated road on the south side, crossing Jinci Road, Haicang Road, and Binhai Second Road in sequence before landing. Then, a section of ground expressway is set up, and a tunnel (with a total length of 760m and a buried section of 270m) is constructed at the intersection of Binhai Fourth Road to connect with the north side cross Shitang Hengjiang Bridge.

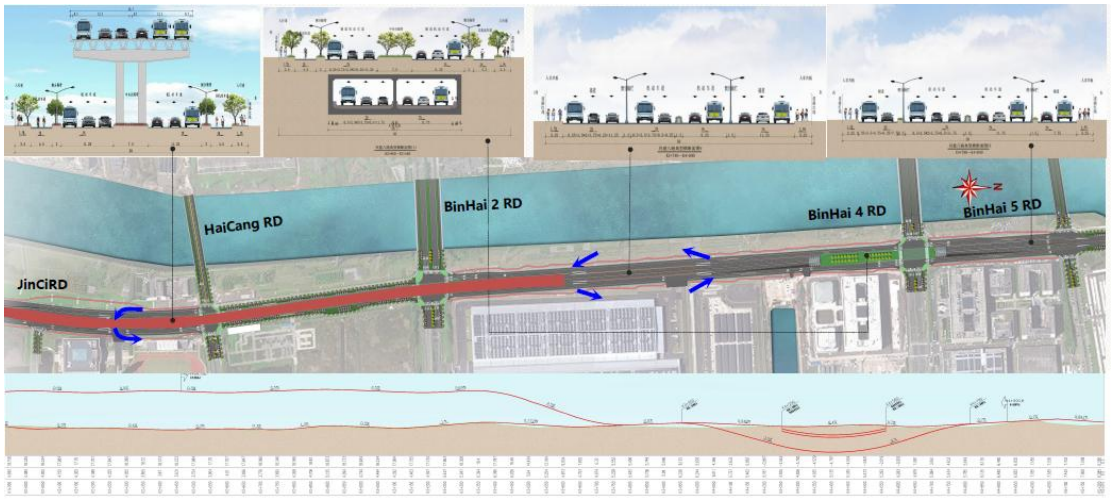

Figure 4-3 Overall Layout of the Elevated and "Short Span" Scheme in Scheme 2

Table 4-1 Overall Scheme Comparison of Phase I Project Section I

Scheme Comparison Scheme 1	Scheme 1: Double Six Medium Tunnel+Short	Tunnel Scheme 2: Double Six Long	Tunnel Scheme 3: Elevated+Short Tunnel
Flat line type index	The centerline is designed according to the planned line position, and the plan is limited by the land red line. Except for the tunnel buried section, which is implemented as "mainline double six+auxiliary road double six", the lane size of other sections needs to be reduced, and the length of the section "mainline double six+auxiliary road double six" accounts for 37.7%.	The centerline is designed according to the planned line position, and the plan is limited by the land red line. Except for the tunnel buried section, which is implemented as "mainline double six+auxiliary road double six", the lane size of other sections needs to be reduced, and the length of the "mainline double six+auxiliary road double six" section accounts for 73.1%.	The centerline is designed according to the planned line position, and the plan is limited by the land red line. Except for the tunnel buried section and the elevated general section, which are implemented as "mainline double six+auxiliary road double six", the lane size of other sections needs to be reduced, and the length of the section "mainline double six+auxiliary road double six" accounts for 52.1%.
Vertical section line type index	There are many undulations in the longitudinal section, resulting in poor driving comfort	The longitudinal profile has less undulations, allowing for smooth driving	The longitudinal profile has less undulations, allowing for smooth driving
Traffic function	It can basically achieve the scale of double six lanes on the main line and double four lanes on the auxiliary road, which can meet the short-term traffic demand. The long-term traffic function may be slightly insufficient, but the conditions for future renovation are reserved	It can basically achieve the scale of double six lanes on the main line and double six lanes on the auxiliary road, which can basically meet the short-term and long-term traffic demand, and reserve conditions for long-term renovation and improvement	It can basically achieve the scale of double six lanes on the main line and double four lanes on the auxiliary road, which can meet the short-term traffic demand. The long-term traffic function may be slightly insufficient, but the conditions for future renovation are reserved
Landscape environmental protection and confidentiality	It does not affect the effect of one bridge and one scenery along the river, and can meet the confidentiality requirements of surrounding research and development and production sites	It does not affect the effect of one bridge and one scenery along the river, and can meet the confidentiality requirements of surrounding research and development and production sites	Conflict with the effect of one bridge and one scenery along the river, making it difficult to meet the confidentiality requirements of surrounding research and production sites
Construction difficulty	(1) The tunnel length is relatively small, the depth of the buried section is relatively small, and there is no entrance or exit of the tunnel ramp. The cross-section is relatively small, and it does not touch the high-voltage lines along th	(1) The tunnel length is relatively small, the depth of the buried section is relatively small, and there is no entrance or exit of the tunnel ramp. The cross-section is relatively small, and it does not touch the high-voltage lines along th	(3) Compared to Plan 1, the tunnel depth is deeper and the construction measures taken are more complex. Overall, the construction difficulty of Plan 2 is higher than that of Plan 1, indicating greater construction difficulty. (1) Elevated sections account for about 50%, making c

	e road section, making the construction difficulty relatively small;	e road section, making the construction difficulty relatively small;	onstruction relatively easy and having minimal impact on existing pipelines; (2) Plan three only involves short and winding pipelines, and there are no major transverse pipelines, making the construction difficulty relatively low; Overall, Scheme 3 is easy to construct
Scheme comparison and selection	Based on a comprehensive comparison of factors such as transportation functions, landscape environmental protection, and economic indicators, it is recommended to adopt Plan 1		

5. Conclusion

This article takes the Xingci Eighth Road Project as an example, based on the project's planning and current situation, combined with traffic volume prediction and current situation analysis, through comprehensive comparison of schemes, the most reasonable scheme is selected from multiple aspects such as feasibility, traffic function, and economy.

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