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Research on Urban Expressway Design Based on New Transportation Concepts

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Abstract: This article is based on the Suzhou Central Expressway project, adhering to the principles of "safety, comfort, ecology, wisdom, and harmony", adhering to the comprehensive, coordinated, and sustainable development concept, guided by the new concept of transportation construction of the Ministry of Transport, integrating the design concept of traffic safety first, resource conservation, environmental friendliness, technological innovation, and intelligent collaboration, and organically combining nature, culture, and roads. The design strives to achieve road aesthetic design, tolerant design, humanistic design, flexible design, and creative design, which is of great significance for the research of ecological smart road design, transportation industry, and sustainable development of nature and culture.

Keywords: Central Expressway; Municipal roads; New transportation concepts; Ecological wisdom.

1. Introduction

Nowadays, green travel and low-carbon travel have become more and more popular, green environmental protection has become an important part of sustainable development, and people have the need to pursue higher quality of life and better transportation. Urban greenway needs to meet people's demand for path environment, and different residents' choice of travel mode affects the quality of urban environment and living standard. Greenway has become an urban development trend due to its various functions and cost saving advantages. Greenway planning and design can help promote the construction of urban ecological humanities and improve the urban ecological environment. The study of urban greenway planning and design and strategy is of great significance and reference value for the construction of ecologically livable cities, the improvement of urban quality and the improvement of people's living environment.

2. Project Overview

2.1. Overview of Engineering Design

The Suzhou Central Expressway passes through Suzhou High tech Zone, Industrial Park, Xiangcheng District, and Wuzhong District, serving as a fast transportation link between various clusters in Suzhou. In the feasibility study stage, Wuzhong section of the Central Expressway is divided into 10.31km west section, 3.0km east section, 7.10km connecting section of the Taihu Lake Resort, and 27.52km south section (using the South Ring Expressway).

This project is Wuzhong Section of Suzhou Central Expressway Project, mainly including the West Line Section, the connecting section of the Taihu Lake Resort, and the east section, with a total length of about 17.1km, including:

(1) Western section

The route starts from Xujiangnan (connecting to Section 1), using the current Jinfeng Road, turns southwest at the intersection of Mudong Road and Jinfeng Road, and follows Zixu Road to the intersection of Zixu Road and Dongshan Avenue. It turns south along Dongshan Avenue and finally reaches the level intersection of Dongshan Avenue and Wuzhong Avenue. The total length of the west section of Section 2 is about 7.07km. Recently, we have been using the Dongshan Interchange to communicate with the South Ring Expressway.

(2) Connecting line of the Taihu Lake Resort

The route starts from the intersection of Dongshan Avenue and Zixu Road, goes west along Zixu Road, avoids Dongxu Xiang Garden, crosses Xujiang River, goes west along the South Belt Expressway, bypasses Xishan Mountain, and turns to the southwest and crosses the Belt Expressway. A tunnel is set under Xiangshan Mountain, and then it crosses Sunwu Road. The total length of the connection section of Lot 2 the Taihu Lake Resort is about 6.98km.

(3) Eastern section

The route starts from the boundary between Wuzhong District and the industrial park (Wusong River), heads south along the current Sutongli Highway, and ends at the intersection of Xingtang Street. The total length of the eastern section of the 2nd section of the route is about 3.05km. Recently, we have been using the Chefang Interchange to communicate with the South Ring Expressway.

The project construction includes road, transportation, intersection, bridge, tunnel, water supply and drainage, lighting, power cable trench, landscape greening, and sponge city engineering.

2.2. Geological Overview

Most of the sites along the western route are existing road green belts with relatively flat terrain. The ground elevation is generally 2.88-6.63m. The landform type belongs to the ancient Xiehu accumulation plain area.

The connecting line of the Taihu Lake Resort spans two geomorphic units, ZK0+000～ZK5+730 and ZK6+330～ZK7+498.9 are the ancient drainage lake plain areas, and the ground elevation is generally 3.6～4.5m. The shallow strata are generally dominated by the Quaternary soil layer, and no bedrock is exposed. The ZK5+730-ZK6+330 line section belongs to the eroded residual hill landform, with the top of Xiangshan Mountain at 86m and the foot of the slope at 10-16m. The abandoned quarry is located at

ZK5+730-ZK6+040. According to the outcrop of the mountain, the surface layer of the mountain is mainly composed of residual slope deposits, with a layer thickness generally ranging from 2 to 3 meters. Below it is argillaceous sandstone, with a simple geological structure and only a monoclinic structure, and no fault structures have been found. The revealed strata are mainly composed of sandstone and argillaceous sandstone in the upper section of the Devonian Wutong Formation (D3W), interbedded with medium thick layers of quartz sandstone. Joints and fissures are mostly in an upright and slightly stretched shape, with a width of 0.5-3mm, and the fissure surface is attached with a thin film of iron oxide.

Most of the sites along the eastern route are existing road green belts with relatively flat terrain. The ground elevation is generally 1.92-3.88m. The landform type belongs to the ancient Xiehu accumulation plain area.

3. Research on Transportation Demand

3.1. Traffic conditions of urban road network

At present, the roads in the central urban area of Suzhou are almost saturated, with over 90% of the main roads having a peak hour load capacity exceeding 0.9. The load capacity of roads in peripheral zones is generally not high, with road load capacity mostly below 0.8. The distribution of load capacity is shown in the figure.

The travel speed of motor vehicles in the central urban area is lower than that in the peripheral clusters, and the speed distribution is shown in the following figure.

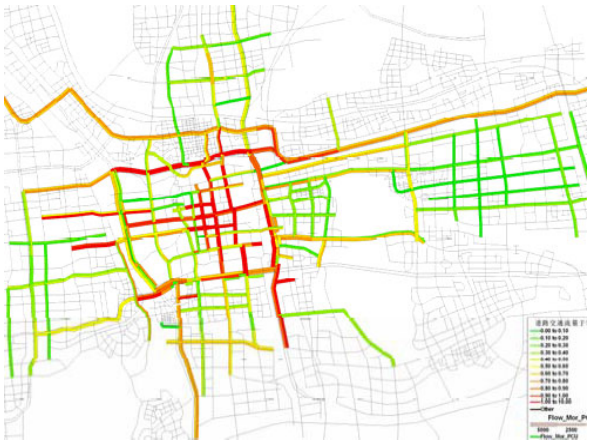

Figure 1. Current road load capacity

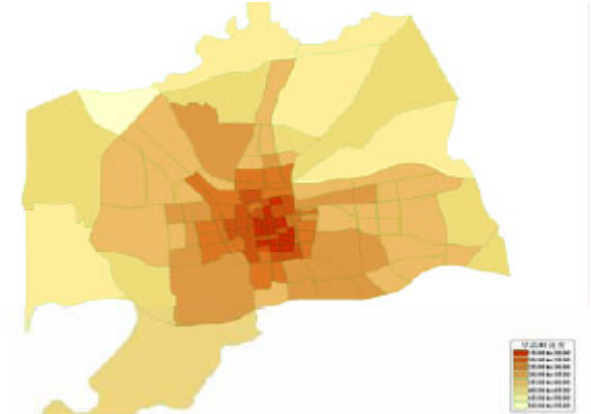

Figure 2. Distribution of average travel speed throughout the day

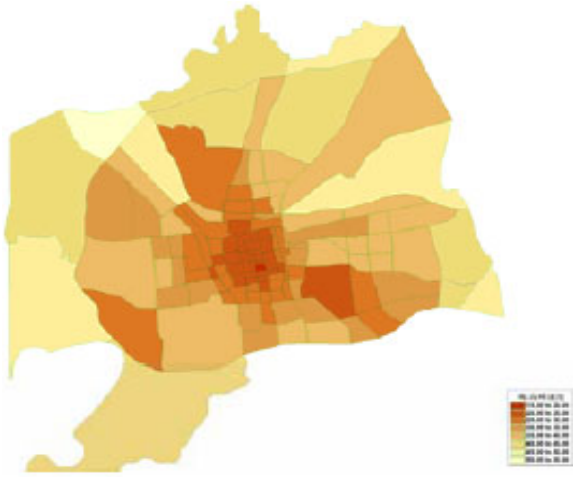

Figure 3. Distribution of average travel speed during morning rush hour

In 2022, the peak hour motor vehicle traffic volume on elevated expressways increased rapidly, with a 63.5% increase compared to the previous year, and the service level significantly decreased.

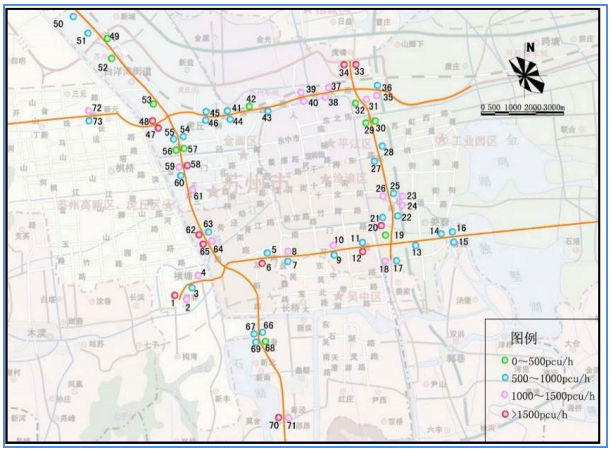

Figure 4. Peak hour traffic volume of elevated ramps in Suzhou urban area in 2022

3.2. Transportation Demand Forecast

(1) Assumption of Transportation Demand

Peak hour coefficient: The peak hour coefficient of the main roads in Conghua District is currently maintained at around 0.08. According to the road planning and transportation development trend in Guangzhou, the rate of change in the peak hour coefficient of roads will tend to be flat in the future. It is recommended that the peak hour coefficient be set at 0.07 in 2035 and the end of the forecast year.

Prediction period: The project base year is 2022, the near term is 2030, the medium term is 2036, and the long term is 2042.

(2) Traffic volume prediction model

① Travel occurrence and attraction: Predicting people's travel characteristics and passenger demand Travel distribution: Adopting a dual constraint gravity model Traffic allocation.

According to the characteristics of this project, a probability model for channel traffic volume, namely multi-path probability allocation method, is adopted in traffic volume prediction.

$$p(r,s,k) = e[\frac{-\theta t(k)}{t}] \div \sum_{i=1}^{m} e[\frac{-\theta t(i)}{t}] \quad (1)$$

In the formula: $p(r,s,k)$ is the allocation rate on the kth travel route; $t(k)$ is the right of way for the *kth* travel route; t is the average right of way (travel time) for each travel route; θ is the allocation parameter; m is the number of effective travel routes.

In order to allocate road networks, "generalized cost" is used as the criterion for determining traffic impedance. Generalized cost=transportation cost + operating time x time value + tolls.

3.3. Traffic volume and service level of the Central Route selection section

The Wuzhong section of the Central Expressway has chosen Jinfeng Road and Zhuyuan Road, as well as the vicinity of S230 Dongshan Avenue, as traffic volume observation points. From the current traffic operation, it can be seen that the peak hour flow near Jinfeng Road and Zhuyuan Road is around 2500pcu/h, and the service level of the entire road section is basically at the B-level. The driving speed is around 40km/h. In the transportation composition, the proportion of trucks is 37%.

During the peak period, the saturation of S230 is at Grade C service level. As the main channel to Guangfu and the Taihu Lake Tourist Resort, the current road standard is low.

3.4. Intersection Road Conditions

There are 25 west lines, 8 the Taihu Lake Resort connecting lines, and 3 east lines along the line that intersect the proposed project, totaling 36. Among them, there are 2 planned expressways, 8 main roads, 14 secondary roads, 10 branch roads, and 2 highways.

3.5. Research on Traffic Volume Prediction

According to the research on traffic demand and forecast results, the average traffic volume of different characteristic years of highways and expressways in the Wu Zhong section of the Central Ring Road during peak hours is shown in the following table.

Table 1. Road Traffic Volume of Central Wu Zhong Section in 2022 (pcu/h)

Road name	Main road flow (pcu/h)	Auxiliary road flow (pcu/h)
West Line Section I	4133	1951
West Line Section II	3162	1708
West Line Section III	3153	1659
East line segment	2996	598
The Taihu Lake Resort	2278	1917

Table 2. Road Traffic Volume of Central Wu Zhong Section in 2036 (pcu/h)

Road name	Main road flow (pcu/h)	Auxiliary road flow (pcu/h)
West Line Section I	6118	2622
West Line Section II	4680	2296
West Line Section III	5200	2229
East line segment	4435	805
The Taihu Lake Resort	3062	2577

3.6. Transportation Service Level

According to the traffic volume prediction results, the western route (from Zhuyuan Road to Zhongshan East Road section) is under high traffic pressure, and the calculated lane size is about 2.1. It is recommended to have six lanes in both directions for the main line of the expressway.

The calculated lane size for the western section and eastern section is between 1.5 and 1.8. Considering that most of the expressways in China currently adopt a dual six lane or above design, based on the actual operation of many expressways both domestically and internationally, the early construction of dual four lane expressways quickly became unsuitable for the development of traffic. Later, newly constructed expressways no longer adopt the four lane standard. Even though a two-way four lane road can meet the needs of normal traffic flow, it inevitably has reliability defects. When using a one-way two lane road, if a vehicle breaks down or a traffic accident occurs on one lane, the one-way traffic capacity of the expressway will immediately decrease to half of its original capacity, and will soon evolve into a situation where the leading vehicles of two fleets refuse to yield to each other, leading to the paralysis of the entire line; If a one-way three lane or more is used, when an accident occurs on one lane, its traffic capacity still retains 2/3 of its original capacity, and it can maintain the smoothness of the road even with low traffic volume. Therefore, it is advisable for expressways to have six lanes, and when four lanes are set up, emergency parking belts should be added. Considering the above considerations, it is recommended that both the West Line and the East Line mainline adopt a dual six lane design.

The connecting line of the Taihu Lake Resort, as a part of the central ring road, not only bears the urban function, but also has the functions of highway connecting line and highway transit. The traffic composition is relatively complex, and the service level of highway traffic is higher than that of urban traffic. In order to ensure the smooth passage of transit roads, it is recommended to use two-way six lane main line.

For the scale of the auxiliary road system, the lane scale of the west line section and the connecting section of the Taihu Lake Resort is calculated to be 1.8~2.1. Considering the consistency of the whole line section and the implementation space under the viaduct, it is recommended that the auxiliary road be implemented as a two-way six lane road, serving the land along the line, and quickly relieving the flow up and down the viaduct ramp.

According to the above traffic volume prediction analysis, the Wuzhong section of the Central Ring Expressway, as well as the main and auxiliary lines of the western and connecting lines, will adopt a two-way six lane standard. The main line of the eastern route will adopt a two-way six lane standard, and the auxiliary road will adopt a two-way four lane standard (the branch road to the terminal section of the eastern route is an urban main road standard, without auxiliary roads). By 2036, it will be able to meet the traffic volume demand, and the service level will be above level C.

4. Design Research Based on New Transportation Concepts

Adhere to the concept of comprehensive, coordinated, and sustainable development, guided by the new transportation concept of the Ministry of Transport, propose a design concept that prioritizes traffic safety, resource conservation, environmental friendliness, technological innovation, and

intelligent collaboration.

The design of this project is based on the principles of "safety, comfort, ecology, wisdom, and harmony", integrating new concepts of transportation construction and organically combining nature, culture, and roads to promote the sustainable development of transportation and natural culture.

4.1. Western Route

The western section mainly involves the reconstruction and expansion of the old road along the current Jinfeng South Road. The land along the eastern side is planned as Xujiang City, with commercial circulation, professional services, modern finance, and leisure and entertainment as the core industries. The land along the western side is planned as a residential agglomeration area in Mudu Town. The current road width of Jinfeng South Road is 30m, and the planned red line width is 60m. The planning on both sides of the route is mainly focused on commercial and residential land, with a high intensity of long-term development. Recently, large residential communities such as Gusu Impression City are under construction. Therefore, the horizontal communication demand for this section is high in both the short and long term, and the planned road red line is narrow. Therefore, the elevated expressway scheme is recommended. The design speed of the elevated main line is 80km/h, and the ground auxiliary road is 40km/h.

According to the actual measurement data of the old road, the horizontal and vertical fitting of Jinfeng South Road was carried out. The plane of this section is an S-shaped section with curve radii of R=500m and R=400m, respectively. The plane indicators are relatively low and cannot meet the design speed of 80km/h for the main line of the Central Expressway; If the reconstruction and expansion are based on the centerline of the old road, it will have an impact on the walls of the Gusu Impression City community and some newly built residential buildings; Therefore, taking into account control factors such as the planned alignment of the Central Ring Road, the planning of land parcels on both sides of the line, and recent demolition of surrounding land parcels, the plane alignment is adjusted to avoid the east side of the Gusu Impression City community wall (with a maximum local offset value of less than 12m), and the S-bend radius is optimized to R=620m and R=525m.

This section is equipped with one pair of up and down ramps on the north side of Gusu East Road, mainly serving the communication between vehicles on the Xujiangnan to Yaofeng section and the West Ring Expressway.

Figure 5. Cross sectional perspective view of elevated standard section

4.2. Connecting line of the Taihu Lake Resort

(1) The starting point of the connecting line of the Taihu Lake Resort is interconnected with S230 hub (mileage stake number: ZK0+500 for fast system, FK0+000 for auxiliary road system). The section from Dongshan Avenue to Xujin Road is a reconstruction and expansion of the old road along the current Zixu Road. The south side of the line is Zixu River, the east side of Dongxin Road on the north side is factory and enterprise land, and the west side of Dongxin Road is equivalent residential land. It is planned as a large-scale residential land, and the current development level of Dongxu Xianghuayuan community is relatively high. The current width of Zixu Road is 28m, and the planned red line width is 43.5m. Since Zixu Road Corridor is the corridor belt of the planned S230 first-class highway, and the red line is narrow, it is recommended that the connecting line of the Central Ring Expressway the Taihu Lake Resort be set with S230. The recommended connecting line for the fast mainline is elevated, with a design speed of 80km/h; As S230 first-class highway, the design speed of the ground auxiliary road is 80km/h.

At the intersection of this section and the Central West Expressway, one S230 interchange will be set up. The rapid system of the connecting line and the rapid system of the western line utilize the interchange ramp for direct and rapid communication, while the auxiliary road system of the connecting line (S230) and the auxiliary road system of the western line are equipped with level crossings for convenient communication.

(2) The section from Xujin Road to the Ring Expressway is designed to utilize the newly built section along the northern corridor of the Ring Expressway. The southern side of the route is mainly used for the Ring Expressway and Xishan Interchange, while the northern side has been urbanized with densely populated residential villages and scattered factories. It is planned to be used for commercial and residential purposes.

The auxiliary road system (S230) in this section is equipped with a separated elevated overpass spanning the existing Sunwu Road, and a pair of up and down ramp entrances and exits are set up on the east side of Sunwu Road, and a pair of ground main and auxiliary entrances and exits are set up on the west side of Sunwu Road, forming a diamond interchange with Sunwu Road to facilitate communication between the auxiliary road system (S230) and Sunwu Road.

4.3. Eastern Route

The starting point of the East Line is located at the boundary between the Industrial Park and Wuzhong District (Wusong River), and is connected to the Central Ring East Line.

The section from Wusong River to Dongfang Avenue is a newly constructed road segment; The section from Dongfang Avenue to the endpoint Xingtang Street is an expanded section of the old road along the existing Sutongli Highway. The plots along the line are located in the suburbs, and except for the Xingtang Street section, which presents a town like situation, the rest are mainly farmland. There are scattered factories along the line, and the overall development level is relatively low. The current Sutongli Highway is 25m wide, and the development level of the land along the route is relatively low.

At the intersection of the planned expressway on the East Line and Dongfang Avenue, one Dongfang Avenue hub interchange is reserved for installation. Recently, utilizing the

current situation of the Dongfang Avenue crossing the Wusong River Bridge and the existing old road auxiliary road system, the East Line Expressway system has set up an elevated section crossing the Dongfang Avenue auxiliary road, and a pair of up and down ramp bridges have been set up on the south side of the main span of the East Line crossing the Wusong River Bridge. After landing south across the Dongfang Avenue auxiliary road on the East Line Expressway elevated section, a pair of ground auxiliary roads have been set up, all of which intersect smoothly with the Dongfang Avenue auxiliary road, forming a diamond shaped interchange, facilitating convenient communication between the East Line Expressway and the Dongfang Avenue auxiliary road, and reserving construction conditions for the future interchange of the Dongfang Avenue hub. In the long term, the rapid transformation of Dongfang Avenue will involve the addition of separate mainline bridges on both sides of the existing Wusong River Bridge. After crossing the East Line Expressway to the east, they will land and connect to the ground level auxiliary road of Dongfang Avenue, and implement the Dongfang Avenue Hub Interchange. The East Line Expressway System and the Dongfang Avenue Expressway System will use interchange ramps for direct and rapid communication, while the East Line Auxiliary Road System and the Dongfang Avenue Ground Auxiliary Road will use level crossings for convenient communication.

The endpoint is the Xingtang Street node. We recommend a level crossing plan in the near future, with a focus on ensuring smooth mainstream traffic between Central and Chefang. As the planning of Xingtang Street is not yet stable, we recommend connecting it smoothly with the current Xingtang Street. After Xingtang Street is expanded and opened to traffic as a main road, the level crossing will be renovated. When the long-term traffic volume increases and the level crossing cannot meet the requirements, a overpass bridge is set up across Xingtang Street to ensure smooth north-south traffic and alleviate the traffic pressure at the final level crossing. If in the future, after the implementation of the overpass on the main line of the eastern route, the final level intersection still cannot adapt to the left turn traffic volume from the Central East Expressway to the Ring Expressway, it is recommended to add a pair of ramps in the northeast quadrant main direction for direct left turn communication.

Figure 6. Standard sectional perspective view

4.4. Roadbed Design

(1) General roadbed design

Remove topsoil and planting soil from the original ground of general road sections, temporarily place them in a centralized manner, and use them for greening purposes after completion. After surface cleaning, the compaction degree of the ground should be ≥ 90%. If the original ground is damp, corresponding engineering measures should be taken (such as sun drying, replacement, or adding ash) to ensure compaction.

When the surface layer of the foundation is made of construction waste or miscellaneous fill soil, it should be removed to 30cm below the original soil and then compacted to a compaction degree of 90%.

(2) Special roadbed design

Some areas within the red line of this project have unfavorable geological soil conditions such as fish ponds, farmland, ditches, artificial fill, and miscellaneous fill. Therefore, it is necessary to treat this soft foundation. According to the requirements of the soft foundation construction period of this project and combined with treatment experience, the soft foundation treatment method of this project is: when the thickness of the unfavorable geological soil layer H ≤ 3m, the removal and replacement method is used; when the thickness of the unfavorable geological soil layer H>3m, the cement mixing pile method is used for deep foundation treatment. The foundation located under the North Third Ring Expressway Bridge is treated with high-pressure rotary jet grouting piles.

(3) Old road subgrade treatment plan

According to the investigation and analysis of the old road diseases, due to inadequate special roadbed treatment, multiple transverse through cracks appeared on the road surface after the completion of the Sutongli Highway. The old road may continue to experience significant settlement, and if the roadbed treatment in the splicing section is too strong, longitudinal cracks will also occur. The treatment method of the spliced section subgrade should pay attention to the coordination with the settlement of the old road, and the strength should be appropriate.

①For general road sections, replacement or composite foundation treatment is selected based on the calculation results of roadbed settlement.

②Select a reasonable special roadbed treatment plan based on the depth, thickness, and settlement calculation results of the soft soil layer for the joint section of the structure, bridgehead, and roadbed. Adopting wet spray pile and PTC composite foundation treatment.

4.5. Slope Protection Design

The maximum excavation slope height of this project is about 38 meters, and the maximum filling slope height is about 12 meters. Therefore, further design research will be conducted on the high slope of the road cut.

1) Fill slope

The filling slope of this project is 8m in one level, with a slope ratio of 1:1.5 for the first level and 1: 1.75 for the second level. A 2m platform is set between multiple levels, and a 2m wide retaining slope and a 0.5m wide drainage ditch are set at the foot of the slope.

For road sections with a slope height of H≤4m, spray seeding and grass planting are proposed for protection; For road sections with a slope height of 4m ＜H≤12m, it is proposed to use three-dimensional mesh grass planting protection, and the slope protection of the waterfront foundation section will use M10 mortar rubble protection.

2) Excavation slope of general road sections

The excavation slope of general road sections is divided into 8m levels, and the slope ratio is currently considered to be 1:1. A 2m platform is set between multiple levels, and a

platform interception ditch is set on the platform. A 0.5m wide side ditch is set at the foot of the slope, and interception ditches are set in sections according to demand 5m outside the top of the slope.

H≤16m road cut slope protection: For road sections with a slope height H≤4m, spray seeding and grass planting are proposed for protection; For road sections with a slope height of 4m＜H≤16m, it is proposed to use three-dimensional mesh grass planting for protection.

3) High slope of road cutting

According to existing data and local project analysis, the high road cut slopes in this area are generally dominated by rock slopes, with some high road cut slopes being soil slopes.

When the excavation slope is over 20m high, it is a high road cut slope, which can be divided into 10m levels. If the high road cut slope is mainly composed of rock slopes, the slope ratio below can be 1: 0.75 except for the highest level which is 1:1, and a 2m platform is set between multiple levels.

If the high road cut slope is mainly composed of soil slopes, the slope ratio can be 1:1 except for the highest level which is 1:25, and a 2m platform is set between multiple levels. The slope ratio of the road cut in this design phase is set to 1:1.

There are three types of slopes in this project where the height of the road cutting slope exceeds 16m, namely: third grade slope (16-24m), fourth grade slope (24-32m), and fifth grade slope (32-40m). The protection design for each graded slope section of the high slope is shown in the table below.

Table 3. Slope reinforcement measures for each graded slope section

Slope section	Slope protection form				
	1	2	3	4	5
3 slope 16~24m	Skeleton	Skeleton	3D Grass	—	—
4 slope 24-32m	Anchor beam	Anchor beam	Skeleton	3D Grass	—
5 slope 32~40m	Anchor beam	Anchor beam	Skeleton	Skeleton	3D Grass

4.6. Road surface design

Based on factors such as climate, hydrology, geology, and roadbed stability along the project route, and in accordance with the basic principles of pavement design, combined with the traffic characteristics of the road section, the pavement design is comprehensively considered.

The pavement structure design of this project adopts the theory of elastic layered continuous system under double circular uniformly distributed vertical load. The standard axle load is a double wheel set with a single axis of 100kN, a tire pressure of 0.7MPa, a single wheel track equivalent circle radius r of 10.65cm, and a center to center distance of 3r between the two wheels for calculation. All parameters are selected according to the "Design Specification for Highway Asphalt Pavement" (JTG D50-2017), and the design indicators for asphalt concrete roads are the rebound deflection value of the road surface, the tensile stress at the bottom of the asphalt concrete layer, and the tensile stress at the bottom of the semi-rigid material layer.

The design lifespan of the pavement structure is 15 years. The pavement structure design of each part is as follows:

Table 4. Pavement Structure of Expressway and Ramp

Name	Ground expressways and ramp roads	Elevated expressway and ramp bridge deck
Upper layer	4cm SMA-13 (SBS) mixed with mineral fibers	
Middle course	6cm AC-20C (SBS) anti rutting agent	\
Lower layer	8cm ATB-25 asphalt crushed stone	6cm AC-20C (SBS) anti rutting agent
Seal	0.6cm slurry seal layer	\
Grass-roots unit	36cm water stable crushed stone	\
Bottom layer	18cm 12% lime soil	\
Total thickness	72.6cm	10cm asphalt pavement+7cm C50 reinforced concrete

4.7. Smart Transportation Design Based on New Transportation Concepts

1) Traffic Engineering Design

This project is Wuzhong Section (Lot 2) of Suzhou Central Expressway Project, mainly including the west line section, the connecting section of the Taihu Lake Resort, and the east section, with a total length of about 17.1km.

The main content of the traffic engineering design for this project includes traffic signs, markings, contour markers, collision barriers, etc. at the Central and reconstructed toll stations, as well as isolation barriers at the reconstructed toll stations of Dongshan Interchange, Shihu Interchange, Guoxiang Interchange, and Chefang Interchange.

2) Smart Transportation and Ecological Roads

This project design incorporates new transportation construction concepts such as smart roads, technological innovation, resource conservation, environmental friendliness, and ecological synergy on the basis of traffic safety.

The intelligentization of roads is closely related to the construction of municipal facilities, with many projects focusing on improving road quality and comprehensive traffic management. The core construction content includes: ①the construction of facilities and equipment based on intelligent transportation; ②Multi pole integrated smart light pole; ③Construction of intelligent road management and service platform.

The design takes "smoothness, intelligence, ecology, and vitality" as the theme, adopting "municipal roads + vehicle road collaborative unmanned driving + intelligent facilities + U-shaped space integration + ecological integration". Strive to create world-class urban expressway quality standards and build Suzhou Central Expressway into a national urban expressway demonstration model.

The road design adheres to the design concept of integrated street space, focusing on the principle of people-oriented. It integrates traffic, recreation, and commercial spaces,

enhances the landscape of the existing road through slope plants, and shapes a street space with pleasant scale, beautiful environment, and green low-carbon.

Respecting the existing road system and spatial logical relationships, integrating various new technologies and ecological restoration into smart city projects through integrated design methods, its significance is not only the improvement of the physical spatial environment of urban roads, but also the renewal and restoration of urban ecology and functions, with strong economic, cultural, social, and ecological benefits. As a pioneer of park cities, we empower urban roads with humanistic, efficient, intelligent, and ecological concepts, allowing them to truly return to serving humanity and life.

Figure 7. Smart and Ecological City Road

5. Summary

This project is based on the Suzhou Central Expressway project, adhering to the principles of "safety, comfort, ecology, wisdom, and harmony", and adhering to the comprehensive, coordinated, and sustainable development concept. Guided by the new transportation concept of the Ministry of Transport, it integrates the design concept of prioritizing traffic safety, resource conservation, environmental friendliness, technological innovation, and intelligent collaboration, and organically combines nature, culture, and roads to promote the sustainable development of transportation and natural culture. We strive to achieve road aesthetic design, tolerant design, humanistic design, flexible design, and creative design in our design.

Road design is not only the process of realizing road functions, but also the process of endowing the designer's ideas and concepts into the creation of roads. The exploration and experimentation in the application of new concepts during the design phase have positive reference value and important significance for the research of ecological smart road design, transportation industry, and sustainable development of nature and culture.

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