



Construction System Architecture, Key Technologies and Practice Cases of Expressway Open Service Area under the Perspective of "Transportation +"

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Abstract. Under the macro background of "Transportation +", the expressway service area is gradually changing from the traditional single function to the open and diversified. This paper deeply discusses the construction architecture, key technologies and practical cases of the expressway open service area, in order to provide theoretical support and practical guidance for the innovative development and efficient operation of the service area.

Keywords: Transportation +; expressway; open service area; construction system

1 Introduction

With the rapid development of transportation and the demand for diversified and personalized travel services, the concept of "Transportation +" has emerged. The "Transportation +" is a concept similar to "Internet +", which represents the new trend of industrial integration. Through the combination of modern transportation technologies, concepts and basic conditions with other traditional industries, new business forms and driving forces for economic and social development are created. The traditional expressway service area, because of its single function, is only a temporary rest point for the majority of travelers, and does not attract attention. Through "Transportation +", the vitality of commerce, tourism, entertainment and other functions is released, and the traditional expressway service area has become "scenic spots", "commercial complex" and other functional areas, with stronger openness, and the service quality and driving role are constantly improved. The open service area under the perspective of "Transportation +" not only provides more personalized and characteristic services for travelers, but also gives full play to the geographical advantages and people flow advantages of the service area, develops characteristic tourism, cultural display, product promotion and other industries, and promotes the development of local economy.

2 Research Status of the Open Service Area

2.1 Characteristics of Foreign Service Areas Connotations of the Openness Attribute

In developed countries and regions, the expressway service area has become a concentrated display window of the local economy, culture and characteristic resources, and a gateway for the expressway passengers to feel the local natural and cultural characteristics, and also brings considerable economic benefits to the operators of service facilities. The open service area of expressway in developed areas of Europe, America, Japan and Taiwan can serve both expressway and places at the same time. Most service areas have a good connection with local traffic, and the open operation mode is adopted to form a better economic interaction with local areas. At the same time, it has the remarkable characteristics of rich business forms, high brand, distinct theme, large scale, flexible layout and good landscape environment.

2.2 Domestic Research and Practice

Domestic research on open service area mainly focuses on functional positioning, layout, coupling with regional economy, landscape design and other aspects. Huang Sheng [1] analyzes the considerations of the location of the service area of the ordinary national and provincial trunk roads, puts forward the idea of the location of the service areas, and establishes a site selection model based on the maximization of passenger flow in the service areas of the ordinary national and provincial trunk roads. Xu Xingchen [2] through practical cases, the planning characteristics and design methods of open service areas in the context of transportation and tourism integration are analyzed, and the design of shared open service areas is preliminarily explored. Zhao Mingfei [3] based on the method of comparative analysis, the functional classification and design ideas of the open service area of the expressway are proposed. Li Qili et al. [4] studied the typical integration model of "service area + tourism" and the functional positioning of single service area + tourism integration development under the background of the new era. Wang Haixia et al. [5] analyzed the significance of the comprehensive economic development of the expressway service area, and proposes that the development of the "six-type" characteristic service area can be implemented according to local conditions. Han Hao [6] proposed to improve the service quality of expressway service areas by improving the design of leisure facilities to provide users with better services. Xue Yanting [7] through examples, introduced the formulation and comparison of joint construction design schemes.

In the research on the construction system of open expressway service areas, China is in the initial stage. From the current construction results, the number of open expressway service areas is also obviously insufficient. Although some service areas have tried to make achievements in function expansion and business form development, the opening degree of the service areas is not high, and the drive to the surrounding areas is not obvious enough.

3 Open Service Area Construction Ideas

3.1 Planning and Design

Site selection and layout: fully carry out the research and analysis of market demand and potential customer groups, consider the connection with the surrounding towns and scenic spots, and the layout of the service area should be reasonable to ensure the convenient connection between various functional facilities.

Function positioning: According to the characteristics and needs of the service area is located, clarify the function positioning of the service area, such as rest, catering, shopping, refueling, charging, maintenance, etc.

Scale and capacity: According to the traffic flow forecast and service demand, determine the scale and capacity of the service area, including the number of parking Spaces, facility area, etc.

3.2 Facilities Construction

Infrastructure: including parking lots, gas stations, charging piles, toilets, etc., to ensure that the basic needs of highway users are met.

Service facilities: build restaurants, supermarkets, convenience stores, etc., to provide a variety of dining and shopping options. At the same time, the rest area and viewing platform can be set up to improve the leisure experience of the service area.

Information facilities: establish an intelligent information service system to provide road information, weather forecast, travel recommendation and other services, to facilitate users to obtain the required information.

3.3 Operation and Management

Service quality: formulate strict service standards and quality management system to ensure that the service area provides quality service. Regularly inspect and maintain the service area to ensure the normal operation of the facilities.

Safety management: strengthen safety supervision to ensure the safety and stability of the service area. Formulate emergency response plans to deal with emergencies and emergencies.

Environmental management: pay attention to the concept of environmental protection, use environmental protection materials and energy saving technology, reduce the impact of service area on the environment. At the same time, strengthen garbage classification and sewage treatment to ensure a clean environment in the service area.

3.4 Local Integration and Characteristic Development

In the construction of the service area, we should fully excavate and utilize the local cultural resources, combine the traditional culture with the modern elements, and create a service area with local characteristics. This can not only enhance the cultural conno-

tation of the service area, but also enhance the understanding and identification of tourists to the local culture.

Local culture exhibition: a local culture exhibition area is set up in the service area to display the local history and culture, local customs and customs, and enhance the cultural connotation of the service area.

Characteristic product development: relying on local characteristic resources, develop products with local characteristics, such as local specialties, handicrafts, etc., to enrich the shopping choices in the service area.

Tourism promotion: cooperate with the surrounding tourist attractions, launch tourist routes and preferential activities, attract more tourists to come to the service area for consumption, and promote the development of local tourism.

3.5 Sustainable Development and Innovation

Continuous investment: according to the operation situation and market demand of the service area, continue to invest funds and resources to transform and upgrade the service area.

Technological innovation: pay attention to the development of new technologies and new applications, actively introduce advanced technologies such as intelligent and green technology, and improve the operation efficiency and service level of the service area.

Mode innovation: explore new service modes and management modes, such as cooperative operation, sharing economy, etc., to promote the innovative development of the service area.

4 Technical Path of Open Service Area Construction

4.1 Site Selection and Optimization of the Open Service Area

Different from the traditional expressway service area, the open service area breaks the restriction of the local road closure, and the spatial location, land use situation, resource distribution and potential value should be comprehensively considered in the site selection.

(1) **Traffic conditions and convenience:** The open service area should take into account the traffic flow, road conditions of the surrounding roads, and surrounding supporting facilities, and should be located in places with certain traffic location advantages, convenient supply of surrounding supporting facilities, and easy operation and maintenance in the later stage.

(2) **Natural environment and landscape:** Based on the attribute of "traffic +" of the open service area, the site selection should be selected with beautiful natural environment and close to resources. Such a location can not only meet the leisure and tourism needs of tourists, but also provide unique landscape resources for the service area and increase its attraction.

(3) **resource advantage and local planning:** open service area site also need to consider the local industry development planning, land use policy, location to adjust

measures to local conditions, combined with local development planning, make full use of existing land resources, coordinate with regional planning, giving full play to the advantages of local resources, also service for the development of regional culture, industry.

4.2 Open Service Area Traffic Organization

The traffic flow line of the open service area can be divided into external traffic flow line and internal traffic flow line according to the service object. The external traffic organization is mainly to ensure that the vehicles can safely and smoothly enter and reduce the impact on expressways or surrounding roads; The traffic organization within the service area is to ensure the safe and orderly traffic operation within the service area.

The traffic organization within the open service area is carried out in accordance with the principles of reasonable functional zoning, separation of people and vehicles, separation of passengers and trucks, and easy identification of signs and lines.

Reasonable and Coordinated Functional Zoning.

The division of functional areas is in accordance with the leisure activity rules of passengers and local people in the area, and is arranged according to the basic services and expanded service zones. According to the functional zoning, the vehicles in the leisure activity area and the expressway service area shall be managed separately. The vehicles in the service area cannot walk through the leisure area. Similarly, the vehicles in the leisure area cannot enter the parking area, so as to avoid the conflict between the vehicles entering the expressway service area and the local vehicles entering the leisure area.

The layout of service area follows the principle of vehicle zoning parking management. Small vehicles are close to the integrated service building and large vehicles run through the driveway. In order to avoid the interference of vehicles and pedestrians, vehicles are separated by using complex buildings, commercial buildings, green isolation belt, etc.

Principle of Human and Vehicle Separation and Passenger and Cargo Separation.

Traffic routes in the parking lot shall avoid crossing; in order to facilitate drivers to park and find vehicles, the driving area is marked with signs, and the parking space is divided and numbered by line marking; parking lots of different types with green belts and compartments to reduce the crossing between different vehicles. Pedestrian and car streamline to avoid interweaving, through the setting of shuttle channels, reduce the distance of walking detour.

4.3 Open Service Area Function and Business Format

Traditional highway service area function is given priority to with standardization, and open service area not only need to have the basic function of traditional service area,

such as parking lot, gas stations, supermarkets, restaurants and toilet facilities, meet the basic needs of drivers and passengers, more because of its broke the closed mode, more should be integrated into the open elements.

Under the Demand Guide, Expand the Functional Business Format.

Rich commercial retail formats: in addition to traditional supermarkets and convenience stores, the service area can introduce more brand stores, featured handicraft stores, etc., to provide passengers with rich shopping options. At the same time, combining the local characteristics and culture, to create a unique commercial atmosphere, to attract more tourists to stop.

Diversified of catering services: In addition to basic fast food and snacks, the service area can introduce local characteristic restaurants, theme restaurants, cafes, etc., to provide a variety of catering experience. In addition, we can also combine the seasons and festivals to launch special dishes and activities to increase the attraction and interest of catering services.

Improvement of leisure and entertainment facilities: the gym, swimming pool, cinema and other leisure and entertainment facilities are set up in the service area, so that passengers can get a full rest and relax during the journey. At the same time, various cultural activities and performances can also be held to enrich the spiritual and cultural life of the tourists.

Improvement of tourism service function: the service area can be linked with the surrounding tourism resources, providing one-stop tourism services such as tourism consultation, tour guide service, scenic spot ticket booking, etc. In addition, tourist routes and products can also be developed to attract more tourists to experience them.

Promotion of intelligent services: using modern scientific and technological means, such as artificial intelligence, big data, etc., to improve the intelligence level of the service area. For example, through intelligent parking system and unmanned supermarket, improve service efficiency and quality; through big data analysis, accurately grasp user needs, and provide personalized service.

Display the Regional Cultural Characteristics.

First of all, the service area buildings should reflect the local cultural characteristics. The appearance of the building can adopt the local traditional architectural style and integrate the regional elements to show the local characteristics. At the same time, a cultural exhibition area can also be set up inside the building to show the local history, culture and folk customs, so that the staff can feel the local cultural atmosphere while having a rest.

Secondly, the decoration and landscape in the service area can also be integrated into the regional culture. For example, sculptures and landscape sketches with local characteristics can be set up in the public space such as squares and green Spaces in the service area to create a cultural atmosphere with local characteristics. At the same time, in the restaurants, shops and other places in the service area, you can also use the decorative elements with local characteristics to create a space with regional characteristics.

In addition, the service area can also carry out regional cultural activities. For example, local cultural festivals, folk performances and other activities can be held regularly to attract the participation of staff and passengers, so that they can personally experience and feel the local cultural charm. At the same time, local non-genetic inheritors and craftsmen can also be invited to show and perform in the service area, so that more people can understand and understand the local cultural heritage.

Finally, the service area can also promote the regional culture through a variety of ways. For example, on the electronic display screen, publicity board and other facilities in the service area, the local promotional videos and cultural introductions will be played, so that the company and passengers can have a deeper understanding of the local cultural characteristics. At the same time, information about the local culture can also be released through the official website of the service area, social media and other channels in the service area to attract more people's attention and understanding.

Integrate into the Concept of Ecological, Green and Environmental Protection.

Green building design: environmental protection and energy saving factors should be fully considered in the architectural design of the service area. Use green building materials, such as environmental protection coatings, energy-saving glass, to reduce environmental pollution. At the same time, through the reasonable building layout and shading design, reduce energy consumption. In addition, the service area can also use renewable energy sources, such as solar energy and wind energy, to provide green power for the service area.

Green traffic planning: The traffic planning of the service area should reflect the concept of green travel. Reasonable parking facilities should be set up, and drivers and passengers are encouraged to choose green travel modes such as public transportation, cycling or walking. At the same time, the traffic flow line in the service area is optimized to reduce vehicle congestion and exhaust emissions.

Green landscape building: the green landscape of the service area is an important window to show the concept of ecological and environmental protection. By increasing the coverage rate of green plants and setting up green belts and ecological wetlands, the ecological environment quality of the service area can be improved. At the same time, local plants are selected to reduce the introduction of alien species and maintain the ecological balance.

Green service facilities: The facilities in the service area should also reflect the concept of green environmental protection. For example, the use of water-saving sanitary ware to reduce water waste; garbage sorting facilities to promote the utilization of waste resources; and energy-saving lamps and air conditioning equipment to reduce energy consumption.

4.4 Utilization of Resources around the Open Service Area

Make full use of the surrounding cultural resources: including historical sites, cultural attractions, folk customs, etc., through these elements into the construction and opera-

tion of service area, not only for the past passenger personnel provide rich cultural tourism experience, at the same time also helps to promote the spread and development of local culture and development, promote the prosperity of the local economy.

Use of surrounding natural landscape resources: through reasonable planning and design, the district surrounding beautiful natural landscape, unique geographical environment and other landscape elements skillfully into the overall layout of the service area, create distinctive theme service area, such as science and education demonstration area, cultural experience area, etc., meet the demand of highway users.

Relying on local agricultural and sideline products resources: Through the cooperation with local farmers and enterprises, local agricultural and sideline products are introduced to provide fresh and healthy food choices for past employees, and at the same time, opening up a broader market for local farmers and enterprises, promoting the development of agricultural industry and rural revitalization.

5 Practice Cases

5.1 Tianqiong Expressway Overview

After the completion of the Tianfu New Area to Qionglai Expressway project, Qiongming Expressway and Chengle Expansion Expressway will be organically linked together, forming the second channel from Chengdu to Ya'an, which will play a role in promoting the construction of multi-level transportation services in the new area and play a positive role in integrating into the integrated development of Tianfu New Area. At the same time, this project will increase the connection between Xinjin County and Qionglai City and the surrounding cities and developed areas, enhance the radiation and radiation receiving capacity, and play an important role in improving the expressway network of the areas along the line, and improving the highway level and traffic conditions of the existing city (county) trunk roads. In addition, Tianqiong Expressway will meet the needs of tourists for "fast forward and slow out", respond to the national policy of integrating transportation and tourism, and effectively guarantee the development of tourism resources in western Sichuan Province.

5.2 Wenjun Service Area Location

Through the site investigation, data analysis and other methods, the service demand, technical conditions, the location of Wenjun service area are studied.

In the preliminary design stage of Tianfu New Area to Qionglai Expressway Project, the service area is located near Guyi Town, but it is far away from the city, the supply of supporting facilities, water and materials are difficult, drainage is inconvenient, the investment and construction cost is high, and the operation and management cost of the service area is extremely high. In order to ensure the function of the service area, reduce the construction cost of the service area and maximize the benefit of the service area, the service area is planned to be located near Qionglai City.

Qionglai is located in the southwest of Chengdu plain, located in Chengdu "half an hour economic circle", 65 km from Chengdu, Chengdu area about 33 km, north and

dayi county, east xinjin district, Meishan city pengshan district, west and yaan city, forth county, south and pujiang county, yaan mountains, is an important transportation hub in western Sichuan region. The location of Wenjun service area has the following advantages:

(1) The service area and Linqiong interchange, toll station and maintenance area, not only reduce land acquisition, can reasonably optimize the use of land, water, electricity and other resources, save construction funds; and can accumulate the popularity of the service area, the service area can be shared with the toll station and maintenance area, easy management.

(2) This location is connected to G318 line and is close to an important material distribution center in western Sichuan: Qionglai Industrial Park and Logistics Park in Tianfu New District. It not only has the geographical advantages of gateway and transportation hub between Sichuan and Tibet, but also can drive the development of relevant local logistics and promote the formation of market.

(3) This location is located in the south of Qionglai City, only about 2 kilometers away from the central city. The service area can be integrated into the local economic development layout and become an organic part of the urban complex, serving the regional economic development.

(4) Qionglai City is "the largest liquor liquor base in China". The service area is adjacent to China liquor village and liquor industrial park, which can become a new growth point of the service area in business. Qiongwine is a specialty of Qionglai City and a national geographical indication product of China. "Since ancient times, Linqiong is called fan shu, especially for wine making", "Wenjun when lu, such as polyester", so that the story of Qiong wine spread through the ages.

(5) The location of the service area here is beneficial, which is conducive to further promotion of Wenjun tea, the hometown of Zhuo Wenjun, a talented woman in the Western Han Dynasty. Wenjun tea's gentle and elegant name has always been praised by literati for its unique ecological environment, exquisite processing skills and the story of Wenjun cooking tea, and it became famous for its "tribute tea" in the Song Dynasty.

(6) Qionglai City is rich in tourism resources, including Tiantai Mountain, Zhuxi Lake, Sui and Tang Wao Site, Pingle Ancient Town, etc., with a unique natural environment. Among them, Wenjun Well is located in Ren Street, Linqiong Town, Qionglai City. According to legend, it is the place where Sima Xiangru and Zhuo Wenjun sell wine. Many tourists come here every year. The service area is located here, and its economic efficiency will be further improved with the development of surrounding tourism resources.

5.3 Traffic Organization

The traffic demand analysis was conducted on tianqiong expressway, G318 traffic, interchange ramp, toll station, and the traffic volume induced after the completion of the service area, and respectively analyzed for holidays, weekdays, weekends, etc. Based on the design conditions and operation requirements, and the method of combining theoretical analysis and simulation technology is adopted to analyze the design technical

indicators and adaptive traffic volume of the key parts of the service area, verify the rationality of the design scheme, and put forward optimization suggestions for the analysis results.

Through the analytical simulations, The scale of parking facilities in the design scheme of Wenjun parking area can meet the parking demand; Service area parking function zoning is reasonable, In line with the zoning management principle of buses and trucks; The service area adopts the process of "parking first, refueling later", According to the streamline design of entering the service area, parking, refueling and driving out of the service area, The driving route for parking and refueling and direct refueling are considered, Reduce the risk of vehicle congestion at the entrance of the service area; Reasonable traffic organization in the service area, Traffic organization streamline is clear, The driving route of vehicles in the service area basically adopts one-way traffic, Avoid mutual crossing; The number of parking berths in the north and south service areas can meet the short-term and long-term parking needs; The parking space in the north service area is greater than the parking demand. Based on the above conclusions, it is suggested to reduce the car parking space in the north service area and optimize the parking area; to optimize the parking area for hazardous chemical vehicles, the distance from the gas station should be less than 50m; the slope of the parking space for large cars and automobile trains should not be more than 2.0%, and the slope of the parking space for the medium and small cars should not be more than 2.0%.

5.4 Functions and Formats

In terms of traffic service function, Wenjun service area is positioned as passenger truck service area; in terms of operation mode, it is positioned as open service area, that is, a comprehensive service area integrating fashionable shopping, characteristic catering and leisure for local citizens; in terms of traffic organization, it is positioned as the traffic organization mode of integrated service area and toll station. Therefore, Wenjun service area should take into account the above characteristics and functions in the planning and design, traffic management and organization.

The functional zoning of Wenjun service area is given according to the site conditions and requirements. According to the big functions, the whole Wenjun service division is divided into three functional areas: leisure area, expressway service area, toll station, and the three functional areas are relatively independent.

The expressway service area includes four sub-functional areas: comprehensive service area (complex building), parking area, refueling area (gas station and equipment room), and toll station.

Combined with research and wen jun service characteristics, combined with qionglai specialty, local customs, ecological economy and cultural elements, innovation into entertainment, life, sports center, cinema, family center, science and technology experience, for the convenience of emergency chain of service function, meet the public "food, lodging, line, swim, shopping, entertainment" diversified consumer demand, as a new open integration theme commercial street.

(1) Diversified specialty food

Wenjun service area will provide Qionglai -- local cuisine, one of the four ancient

cities of 2300 years, including the sharing of delicious tongue of numerous host and guest: zhou duck, milk soup noodles, bowl chicken, old hemp cake, hot lamb, western food, popular food, Chinese food and other popular food, fully demonstrate the diversity of food culture.

(2) Ethnic customs and specialties

Wenjun service area will display features from Qionglai special products qiongwine, Qiongyao, Qiongtea and other ethnic customs products and tourism memorial surrounding products, combined with local folk culture elements, to create a commercial street gathering popularity through the way of commodity sales.

(3) Qionglai ancient landscape experience

Wenjun Service Area will create Qionglai ancient landscape experience area to present the ancient scenery of Linqiong, which has a history of more than 2,300 years. The technology of combining light and vision will give the drivers and visitors in the area immersive culture and rich five-sense experience in different scenes.

6 Conclusions and Outlook

The study of construction architecture, key technology and practice case of expressway open service area has great practical significance and broad application prospect. Through continuous optimization of the construction system architecture, in-depth application of key technologies and learning from successful practice cases, the expressway service area can be promoted to a more open, intelligent and efficient direction, and provide the public with more high-quality and convenient travel services.

In the future, with the in-depth promotion of the "Transportation +" strategy and the continuous innovation and development of technology, the expressway open service area will achieve greater breakthroughs and improvements in functional positioning, facility construction, resource allocation, information and intelligence and other aspects, and inject new impetus into the sustainable development of the transportation industry.

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