Study on the Design of Slow Travel System of Tourist Highway Service Facilities

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Abstract. As an important carrier of tourism development, tourism highway also develops rapidly, and the construction of service facilities also rises gradually. The research on the slow travel system of tourism highway service facilities will help to achieve the coordinated development of eco-tourism and green development. Based on the concept of tourism highway service facilities, this paper defines and classifies the slow traffic system of tourism highway service facilities, and studies the slow traffic system of tourism highway service facilities from three aspects of slow traffic line design, safety facilities design and sign system design, and puts forward relevant design suggestions. Finally, through the field investigation of Yanming Lake Wetland Park in Jilin province, the slow system design is carried out, and the overall design drawing is proposed. Through the analysis and research of this paper, it can improve Chinese design system of slow traffic under the service facilities of tourism highway, and has the corresponding guiding role for the design of different slow traffic systems.

1. Introduction

With the rapid development of China's tourism industry, the tourism highway also shows a strong momentum of development. As an important factor in the development of tourism highway, the construction of tourism highway service facilities is also gradually rising. In 2017, Chinese government also proposed to support the construction of "slow travel" transportation network to meet the tourism experience. As an important link in the construction of tourism highway service facilities, the design and research of slow travel system responds to the national strategy, fully embodies the characteristics of healthy tourism and green transportation, and is conducive to the mutual promotion and coordinated development of eco-tourism, global tourism and green development. The travel purpose of tourists on tourist roads tends to experience the natural landscape in depth and get physical and mental enjoyment. In order to better meet the needs of tourists for the extension of tourism highway function and enrich the connotation of tourism highway, the slow travel system, as a slow walking path and auxiliary facilities connecting different tourism highway service facilities or arranged in the scenic area inside the tourism highway service facilities, has many functions such as leisure and sightseeing.

The research on greenway network and slow traffic system is one of the hot spots in the academic circles at home and abroad. The research on greenway network mainly involves the spatial planning [1] and design concept [2] of different greenway networks. The research on slow traffic system mainly...
focuses on the architecture [3], planning method [4], space construction [5], facilities supporting [6] and function planning [7] of slow traffic system network. The study of greenway slow traffic system is mainly from the aspects of spatial planning [8] and landscape planning and design [9], and the representative case studies of greenway slow traffic system are mainly Singapore Park connecting road system planning [10] and Tokyo Fiber City 2050 planning [11]. Compared with the slow traffic system of greenway, the slow traffic system of tourist highway service facilities combines the service facilities of tourist highway with the slow traffic system. At present, the research and analysis of greenway network and slow traffic system pay more attention to the relevant contents of planning and design and function planning. However, on the basis of the original landscape, the research on the slow traffic system design of the service facilities of the tourism highway pays more attention to the integration of the service facilities and the surrounding environment and other relevant elements. Based on this situation, the design and research of slow travel system of tourism highway service facilities can provide a reference for the later construction of tourism highway service facilities and the introduction of relevant specifications.

In this paper, the slow travel system of tourism highway service facilities is designed and studied. Firstly, the slow travel system of tourism highway service facilities is defined and classified according to relevant literature and research status. Then from the line design, safety facilities design and sign system design of the slow traffic system of the service facilities of the tourism highway are studied. Finally, combined with the field investigation case of Jilin province, the slow travel system of a tourist highway service facility in Jilin province is designed. Through the analysis and research of this paper, it can improve the slow traffic design system of tourism highway service facilities, and also has a certain guiding role in the design of slow traffic system in other areas.

2. Related concepts of slow traffic system of tourism highway service facilities

2.1. Definition of slow travel system for service facilities of tourism highway

Combined with domestic and foreign literature and research status at home and abroad [12-13], the slow traffic system of tourist highway service facilities can be defined as the slow-moving footpath and auxiliary facilities set up in the service facilities land, which can make tourists accessible to different facilities and experience the natural landscape in depth. The slow traffic system of tourism highway service facilities focuses on two characteristics of slow and tour, which is a transportation system integrating leisure, sightseeing and environmental protection functions.

2.2. Classification of slow traffic system of tourist highway service facilities

Combined with the definition of slow traffic system of tourism highway service facilities, its classification and specific meaning are shown in Table 1.
| Classification standard of slow moving system | Slow traffic system type | Meaning and function | Diagram |
|-----------------------------------------------|--------------------------|----------------------|---------|
| Types of connect                               | Slow moving system between service facilities and observation points | Connect different service facilities of tourist roads to achieve the purpose of convenient travel for tourists. | ![Diagram](image1) |
| Slow traffic system in service facilities      | Slow traffic system in service facilities | Tourists can fully experience and appreciate the scenic features of the scenic spot, and achieve the purpose of in-depth tour in the form of slow lane. | ![Diagram](image2) |
| Forest type slow traffic system                | Forest type slow traffic system | Slow traffic system based on forest tourism highway. | ![Diagram](image3) |
| Lake type slow traffic system                  | Lake type slow traffic system | The slow-traffic system is set up along the lake, with changeable hydrological forms or rich human accumulation as the core. | ![Diagram](image4) |
| Wetland type slow traffic system               | Wetland type slow traffic system | Relying on the wetland, the main functions are slow travel, sightseeing and short-term rest. | ![Diagram](image5) |
| Cultural slow traffic system                   | Cultural slow traffic system | With historical heritage or folk culture as the core, build a slow system with strong educational function. | ![Diagram](image6) |
| Ice snow type slow traffic system              | Ice snow type slow traffic system | With ice and snow cultural festival or ice and snow landscape as the core, build a slow travel system to meet the viewing function. | ![Diagram](image7) |
| Slow riding system                             | Slow riding system | The way of main slow-moving system is bicycle. | ![Diagram](image8) |
| Traffic type                                   | Slow walking system | A slow traffic system that takes walking as a way of travel. | ![Diagram](image9) |
| The comprehensive slow travel system of riding and walking | The comprehensive slow travel system of riding and walking | The combination of walking and cycling can meet the different needs of travellers and the requirements of different topography for road design. | ![Diagram](image10) |

3. Design of slow travel system for service facilities of tourism highway

Combined with the definition and classification of slow traffic system under the service facilities of tourism highway, the design of slow traffic system under the service facilities of tourism highway mainly includes line design, safety facilities design and sign system design. Good line design not only ensures the use of roads, but also improves the travel comfort and safety of tourists. According to the service facilities and environmental factors around the scenic spot, a reasonable design of safety
facilities can fully guarantee the safety of tourists; the sign system design is the embodiment of the overall service image of the slow traffic system under the whole service facilities, and the standardized sign system is the basic requirement of the slow traffic system.

3.1. Line design of slow lane

According to the terrain and landform of the area, reasonable design of the width of the slow lane can provide a comfortable experience for slow walkers, better interaction with the environment, so as to achieve the purpose of deep natural experience. Appropriate slope setting can make slow walkers not consume too much physical energy and cannot fully enjoy the scenery.

3.1.1. Width design of the slow lane. The width of service facilities of different types of tourist roads can be designed and analysed according to the landscape type of service facilities. Combined with the summary of relevant specifications, the recommended width of the slow way is as specified in Table 2.

Table. 2 Slow lane width suggestion form.

| Classification                  | Pedestrian road | Cycleway          | Comprehensive road |
|---------------------------------|-----------------|-------------------|--------------------|
| Forest type slow traffic system | Set separately | Not recommended   | Not recommended    |
| Lake type slow traffic system   | ≤2m; ≥1.5m;     | 3-4m;             | ≥5m                |
| Wetland type slow traffic system| Adjust measures to local conditions; Unsuitable widening | Meet the demand of bicycle passing | |
| Cultural slow traffic system    | ≥2m             | One way≥2m        | ≥6m                |
| Ice snow type slow traffic system | Set separately | Two way≥4m        |                    |

3.1.2. Slope design of slow lane. The slope design of the slow way under the service facilities of the tourism highway is divided into the cross slope and the longitudinal slope design, and the terrain and the natural environment should be fully considered in the design. In combination with the relevant planning and design guidelines and the landscape and terrain environment of different areas, the gradient design suggestions of the slow way under the service facilities of the tourism highway can be as shown in Table 3. When the actual terrain factors cannot meet the slope requirements in Table 3, the slope length shall be limited according to table 4 according to the specific slope requirements.

Table. 3 Slow lane slope suggestion form.

| Classification                  | Traffic type classification | Longitudinal slope grade | Cross slope grade |
|---------------------------------|-----------------------------|--------------------------|-------------------|
| Forest type slow traffic system | Pedestrian road             | When >8%, supplemented by step steps | — |
| Lake type slow traffic system   | Pedestrian road             | 0.3-2.5%                | ≤1%               |
| Wetland type slow traffic system| Comprehensive road          | <1.5%                   | ≤2%               |
| Cultural slow traffic system    | Pedestrian road             | When 3-8%, supplemented by step steps | ≤1% |
| Ice snow type slow traffic system| Pedestrian road             | 0.3%-1%                 | — |
3.2. Design of safety facilities for slow lane

3.2.1. Analysis of safety characteristics of slow traffic system. Slow traffic safety facilities of tourism highway service facilities play a very important role in protecting tourists. Combined with the characteristics and classification of slow traffic system of tourism highway service facilities and other related factors, the existing security risks mainly include the following two types:

(1) Safety problems of slow traffic road side: in order to ensure the safety of tourists, generally slow traffic road side should be equipped with safety barrier facilities, and different height and material safety barriers should be set according to different types of slow traffic system.

(2) Safety problems of special road sections: for the slow traffic system under different types of service facilities of tourism highway, there are problems similar to the larger angle of curve, etc., and anti-skid materials can be set according to the actual situation to improve the safety factor of road traffic.

3.2.2. Setting of safety facilities for slow lane. The safety facilities of the slow traffic system under the service facilities of the tourism highway include the safety guardrail and the protection settings of the special sections. The corresponding design should be adapted to the terrain and environmental landscape of the slow traffic road, so as to ensure the safety of the tourists. Generally, when the height difference between the edge of the normal activity range and the free space is more than 1 m, guardrails shall be set up, and the height shall not be less than 1.05m. when the water depth is more than 0.7m, guardrails shall be set up on both sides of the slow lane, and the height of the handrails shall not be less than 1.1m [14]. The pavement materials of different materials shall be used for physical distinction between the riding and walking comprehensive lanes. According to the slow traffic system under different types of tourist highway service facilities, the recommended safety facilities are shown in Table 5.

Table. 5 Suggestions for setting up safety facilities of slow traffic system under tourist highway service facilities.

| Classification basis | Types                        | Suggestions for setting up safety guardrails | Suggestions for setting up special sections |
|----------------------|------------------------------|---------------------------------------------|---------------------------------------------|
| Forest type slow traffic system | Generally, wooden guardrail and rope guardrail are the main ones, and the height is about 1m | For steep sections, guardrails can be increased appropriately, and the road surface friction force can be increased |
| Lake type slow traffic system | Generally, wooden guardrail, rope guardrail and steel guardrail are mainly used, with height ≤ 1m | Strengthening and heightening guardrails in dangerous sections such as fast water flow |
| Wetland type slow traffic system | Guardrail is not required. If necessary, steel guardrail and iron guardrail are mainly used, with height ≤ 1m | For the cycling road, the road friction can be increased appropriately |
| Cultural slow traffic system | Generally, it is mainly rope guardrail and steel guardrail, with a height of about 1m | Increase antiskid pavement material when the angle of curve is large |

Table. 4 List of design requirements for slow road limit slope length.

| Classification     | Longitudinal slope grade | Limiting slope length |
|--------------------|--------------------------|-----------------------|
| Pedestrian road    | 2.5%≤i<3%               | 300m                  |
| Cycleway           | 3%≤i<3.5%               | 200m                  |
| Comprehensive road | 3.5%≤i≤8%               | 100m                  |
3.3. Design of slow lane sign system

The sign design of slow traffic system under the service facilities of tourism highway is to guide tourists to complete various information expressions and signs of slow traffic. Its main function is to indicate the route and direction of the slow traffic system. The reasonable design of the elements of the sign system plays an important role in guiding the design of the slow traffic system under the service facilities of the tourism highway. In this paper, the slow traffic system signs under the service facilities of tourism highway are divided into three categories: one is the interpretation signs of service facilities and scenic spots, the other is the guide signs on the slow traffic road, and the other is the management signs that tourists should follow.

(1) Sign form design

The design of sign form should make full use of the engineering theory as a guide, according to the morphological elements such as the characteristics of animals and plants, geology and geomorphology of the area, combine the actual form with the conceptual form, and design a sign that is in harmony with the regional characteristics. At the same time, it can meet the visual requirements of people and pursue the artistic sense of the sign form in the form of diversified design. The common sign form design is shown in Table 6.

| Sign form          | Features                                      |
|--------------------|-----------------------------------------------|
| Triangle / circle  | Safety warning sign                           |
| Rectangle          | The area for using is large, clear and orderly |
| Square / combo shape | For guide signs and auxiliary signs           |

(2) Sign material selection

The sign material shall be durable and corrosion-resistant according to the national regulations, and the service life, ecological environmental protection and economic factors shall be considered. In addition, the selection of sign material shall be fully consistent with the slow traffic system environment and local cultural characteristics, and the sustainable development of material use shall be considered to fully reflect the concept of environmental protection. Table 7 shows the recommended materials of common signs in the slow traffic system of different types of tourist highway service facilities.

| Classification                        | Sign material selection          | Characteristics and causes                                                                 |
|---------------------------------------|---------------------------------|-------------------------------------------------------------------------------------------|
| Forest type slow traffic system        | Wood, stone                     | The system needs to be highly coordinated with the environment, durable, corrosion-resistant and low cost |
| Lake type slow traffic system          | Wood, stone, concrete           | These system signs need to be processed easily, durable, highly coordinated with the environment, and not easy to corrode |
| Wetland type slow traffic system       |                                 | The system signs need intelligent materials that are light in weight, easy to make and can change information according to the actual situation |
| Cultural slow traffic system           | Metal, plastic, LED information board |                                                                                        |
| Ice snow type slow traffic system      | Metal, glass, composite         | The system needs materials with strong plasticity and sense of art, light transmission and high stability |

(3) Text content design

The design of the text content should not be too complicated. The concise and popular text should be used to convey the clearest and most comprehensive information to the travellers. At the same time, the guidance of the text content should pay attention to the accuracy and characteristics. In the design of the sign system, multilingual design should be adopted according to the local folk culture and the
country of tourists to meet the language requirements of different tourists. The font should be set in different sizes according to the specifications, and the line spacing should be appropriate. The colour of the font and the colour of the signboard should form a strong contrast to enhance the recognition effect of travellers.

(4) Colour selection

The principles of coordination, clarity and humanization should be fully considered in the colour design of the logo. The coordination of colour means that the selection of colour should be consistent with the whole system environment, not too similar to the system environment, nor too abrupt. The colour of the logo should have strong clarity, so that the tourists can clearly distinguish the content and direction of the logo. The humanization of colour refers to the design of distinctive colour matching on the basis of meeting the needs of the public, which should fully meet the psychological perception of travellers.

4. Case study

4.1. Overview of Yanming Lake Wetland Park in Jilin province

Yanming Lake Wetland in Jilin province is located in Dunhua city, Yanbian Korean Autonomous Prefecture, Jilin province, China. It is located in the lower reaches of Mudanjiang River and at the junction of Jilin and Heilongjiang. The wetland in Yanming Lake Reserve can be divided into 2 types, which belong to natural and artificial wetland systems. The wetland area of the area is 18905 hectares, accounting for 35.0% of the total area of the area. Among them, the area of natural wetland is 17357 hectares, accounting for 91.8% of the wetland area in this area; the area of artificial wetland is 1548 hectares, accounting for 8.2% of the wetland area in this area.

In this survey, a wetland park in Mudanjiang section has built a slow way. According to the connection type, it can be defined as a slow way system in the service facilities, and according to the tourism resources, it can be defined as a wetland slow way system. The whole slow way is similar to bird with a long length, covering a wide range of areas. It is laid by wood as a whole. The width of the slow way is 1.99m, with safety guardrails, and the height is 0.72M, but it is not very stable. Due to seasonal reasons, the scenery around the wetland is not distinctive, so the density of people flow is low, as shown in Figure 1 (a-c).

![Figure 1(a-c) Related figure of Yanming Lake wetland park.](image)

4.2. Design and analysis of slow travel system of Yanming Lake Wetland Park

The slow traffic system design of Yanming Lake Wetland Park can be divided into three categories: line design, safety facilities design and sign system design. The specific planning and design are shown below.

(1) Line design

According to the actual survey of the overall landform of Yanming Lake, combined with the plan, in the slow-moving system of Yanming Lake wetland, the line design of the slow-moving road is in the form of straight line and curve connection, combined with the original bird shape of Yanming
Lake scenic area, the original slow way is mainly treated at the intersection point. The overall system is mainly pedestrian road, and some areas around the wetland can be set with cycling road.

In terms of the width design of the slow way, combined with the above table of suggestions on the width of the wetland slow way and the data obtained from the actual investigation, the width of the original pedestrian way is 1.5m, which has problems in the evacuation of people and the parallel experience of two people. Therefore, according to the table of suggestions, the width of the pedestrian way is set to 2m, due to the lack of cycling roads in the original facilities, considering the beautiful scenery of the extension part of the road where the wetland is located, a cycling road can be added for riders, with a width of 3.5m in line with the recommended table. In terms of the gradient design of the slow way, the terrain of the whole Yanming Lake Wetland Park is relatively flat, and the gradient design can meet the requirements according to the actual terrain and the above-mentioned suggestion table. In this paper, it is suggested that the gradient of the pedestrian road and the cycling road can be set as the longitudinal gradient less than 1.5% and the transverse gradient less than 2%. After the design, the length of the walking path and the riding path of the slow traffic system is 1965 m and 900 m respectively.

(2) Design of safety facilities

There are two main safety problems in the slow running system of Yanming Lake wetland. On the one hand, the pedestrian way is mainly set above the wetland, and there is a difference in the free height, so safety barriers should be set up to ensure the safety of tourists; on the other hand, there is a large angle of curve in the addition to strengthening the barriers, ground protective materials should be set up to improve the safety factor. According to the field survey, the water depth of the wetland reaches 0.7m, and the original guardrail height is 0.72M, which cannot meet the requirements of effective protection of slow walkers. The safety guardrail should be increased to 1.2m. In combination with the surrounding landscape viewing comfort and coordination, it is recommended to use wooden guardrail for the pedestrian way, and steel guardrail and anti-skid material for the cycling way to increase the safety factor.

(3) Sign system design

In the actual investigation, the sign system of the whole slow traffic system only has one slow traffic guide sign, and there is no perfect sign system. Therefore, the slow traffic system of Yanming Lake Wetland needs to add slow traffic and cycling guide signs, management signs and other guide signs; The material of the sign is mainly made of wood, and the colour of the sign should be in sharp contrast with the colour of the text. Because this is a national scenic spot and close to North Korea, the sign language can be set in the trilingual mode of Chinese, English and South Korea, and the specific location and overall design plan of each sign are shown in Figure 2.
5. Conclusion
The slow traffic system under the service facilities of tourism highway is based on the service facilities, so that the tourists can have a deep experience of the scenery of the road system. In this paper, combining the concept of the service facilities of tourism highway and tourism highway and the actual investigation, the slow traffic system under the service facilities of tourism highway is defined and classified, which is conducive to the subdivision of the service facilities of tourism highway, it provides the basis for the overall functional connection planning and design; according to the classification of slow traffic system, it analyses the design of slow traffic line type, safety facilities and sign system, and puts forward relevant design suggestions, which promotes the development of slow traffic system design of tourism highway to standardization. Finally, the case study combined with the field survey of Jilin province, analysed the appropriate design data, analysed the current situation of the slow travel system of Yanming Lake Wetland Park and improved the design, and gave the overall design diagram. Through the research and case analysis of this paper, we can improve the definition and design guide of slow traffic system under the service facilities of tourism highway, which has a certain guiding role in the design of other service facilities slow traffic system.

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