Landscape Analysis of Urban Bike Aerial Lanes—Take Xiamen Aerial Bike Lanes as an Example

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Abstract. The urban aerial bike lanes landscape not only provides convenient transportation for urban residents, but also shoulders the vital task of enhancing the urban image. And it has become an essential factor of the sustainable development of urban three-dimensional landscape. Through the research and analysis of the aerial bike lanes landscape in Yunding Road, Xiamen, this thesis summarizes the enlightenment and reference of the urban aerial bike lanes design, which is of great significance to the urban sustainable landscape development in the future.

Introduction
In the 1920s, Le Corbusier, the famous architect, put forward the idea of "Modern City". He argued that the city should adopt a multi-level three-dimensional traffic system that echoes the tall buildings in the city as a vertical development of urban space Path [1]. Since then, the development of the three-dimensional space of urban traffic has aroused a lot of attention in society. But most of their forms appeared to be a single form, only serving as overpasses and viaducts of cars with less human care. It will lead to the inconvenience of pedestrian and urban public transport, which has a certain deviation of urban people-oriented human direction of development. How to deal with such single three-dimensional urban traffic mode has become an essential topic.

Taking Xiamen's aerial bike lanes as an example, this thesis shows us three parts of research and analysis of the aerial bike lanes in the three-dimensional urban traffic space, which are the design methods of the aerial bike lane in urban traffic three-dimensional space landscape, especially in function, enlightenment and reference. Xiamen is the first city to combine aerial bike lanes with overpasses and viaducts in China. Through combination of three vertical traffic spaces, the top, the middle, and the low, it could simultaneously accommodate upper vehicle driving, middle bicycle riding, and pavement of pedestrians. Having such a vertical traffic space, it could achieve much more function needs for pedestrian, and provides more trip modes for people in the same limited space. No matter you want walk home leisurely, or you want riding apace on high speed road, this combined space form could satisfy your requirement.

Design Techniques of Aerial Bike Lanes Landscape in the Three-dimensional Landscape of Urban Traffic

People-Oriented Design Techniques
Landscape, does not mean just a visible beauty, but also includes space for people to enjoy a variety of characteristics from the survival of society and nature [2]. Just the same as Dissing+Weitling, an architecture company in Copenhagen, designed Cykelslangen with the help of local government. Cykelslangen is an aerial bicycle lane connecting to both sides of the city port and it has released riders from the congestion sidewalk. The aerial bicycle lane started at Havneholmen, winding by Fisketorvet, bypassing the mall main entrance, which can provide riders adequate riding space. It mainly adopts the people-oriented design concept, which could avoid the collisions between pedestrians and bicycles or other two-wheeled vehicles, and provides effective routes for bicycles to pass the district, and can make riders feel the special beauty of the harbor. The landscape space is
ultimately designed for people. The landscape of the aerial bike lanes embodies different human factors. It takes residents, visitors, adults, kids as the basic starting point in the design, analyzes different psychological needs of people during riding, and then enhances the citizens and tourists' participation and sense of belonging of the landscape environment.

Xiamen's public transport system locates in the first level of China, known as the most suitable public travel city title. On January 26, 2017, Chinese first aerial bike lanes combined with urban flyover and viaduct began operation. The main road along the Xiamen Express Bus (BRT) layout on both sides, cantilevered between the BRT and the ground, from the Hongwen station to the Xianhou station, a total length of 7.6 km (as shown in Figure 1). The whole driveway has a total of 11 entrances and exits, with 6 links to the BRT station, 4 to the mall office building and 3 to the pedestrian bridge, allowing people to move freely among the urban transport hubs, which reflects the people-oriented design techniques. The vertical combination of bicycle lane, ground and BRT lanes effectively enriches the traffic three-dimensional space landscape, which represents the development has entered a new era. And it is also a port of full urban service system to the pedestrian traffic landscape.

During the design of aerial bicycle lane, a people-oriented design approach leaded the whole process. And its design advantages are expressed in four ways: First of all, the combination of ergonomics and landscape design of aerial bike lanes reflects the people-oriented design concept of bicycle lane landscape. Second, the experience of cycling through the aerial bike lanes can increase people's green awareness of environmental protection and enhance people's physical fitness and physical and mental health. Third, the concept of environmentally friendly economy is gradually gaining popularity. Choosing an aerial bike lanes not only saves time for traffic jams from home and work, but also saves the economic efficiency of fuel problems. Last but not the least, relatively slow experiences about regional culture remained longer time in the memories of citizens and tourists alike riding aerial bicycle lanes.

Figure 1. Aerial bicycle lane circuit diagram.

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Environment-Based Design Techniques

Landscape designers could be familiar with all aspects of nature. It is not until a parcel or landscape area shows its natural characteristics, but a harmonious relationship with nature [3]. Therefore, the influence of environmental factors in the area, including space, ecology, rainwater, animals and plants, should be all taken into account in the design of the urban aerial bike lanes (as shown in Table 1). Taking full advantage of these environmental factors allows for a better integration of the aerial bicycle lane landscape into the urban environment.

Xiamen is a subtropical maritime monsoon climate, with flat the terrain, and four seasons are like spring. So it is a city suitable for cycling. In order to improve the image of Xiamen's green city, designers designed an aerial bike lanes landscape between the BRT lanes and the ground in the central part of the city. The overall landscape is north-south and provides citizens with a green and healthy way of traveling.

The natural aspect of urban aerial bike lanes landscape has four sections. First, in conjunction with the city's topography and the height of the BRT lane, designers set the air bike lane 5 meters down from the ground and 4.3 meters to 5.8 meters upward from the BRT lane, forming a three-dimensional traffic space (as shown in Figure 2). Second, Xiamen is a city suitable for growing plants all year round, adorning colorful plant boxes and climbing green plants on both sides of driveways and even on icy bridges. Therefore, people experience the colorful visual experience in the driving process. A large number of birds play and feed here, which fully proves the natural conditions of the air bike lane landscape to fully meet the requirements of bird survival, and also highlights the environmental-based design advantages of the aerial bicycle lane landscape (as shown in Figure 3). Third, the driveway has a rainwater drain every 20 meters. When it rains, the surface rainwater is collected through sewer pipes and used for watering plants on the driveway. Thus, the urban water resources are saved and then be reused in the underground irrigation system. Lastly, the emission of urban automobile exhaust has become the culprit of environmental pollution and caused the greenhouse effect. The design of the landscape of the air bicycle lanes shows a green and environmentally friendly way of life. It is observed that many local citizens and tourists are trying from the beginning to experience the attitude, when they ride, the entire body is heated up due to exercise, the tired body has been eased, the whole people are a lot of spirit, not only environmental protection but also good for the body. So why not choose this more environmentally friendly and healthy way to travel it? Later, more and more people choose this mode of travel, which effectively strengthened the sustainable development of urban ecological environment.

![Figure 2. Three-dimensional traffic landscape’s hierarchical form.](image)
Function Analysis of Air Bicycle Lane Landscape in Three-dimensional Landscape of Urban Traffic

Urban Landscape Space Function

The functional quality of outdoor space has a great impact on various outdoor activities, especially a large number of entertaining and social activities. The improvement of functional quality of outdoor space has created favorable conditions for these activities [4]. The combination of aerial bike lanes and BRT lane creates a high-quality and user-friendly three-dimensional urban public transportation landscape space. For example, Caitang Station, the starting point for bicycle lanes, links the aerial bike lanes with the BTR platform and Ruijing Square. Residents or visitors can freely shuttle among BRT stations, shopping malls, aerial bike lanes and overpass to form a three-dimensional traffic space landscape (as shown in Figure 4).

Each stop has a dedicated parked public bike and social bike platform for visitors to park or rent them. Bicycle entrance is designed in two ways. One is in the station where there is sufficient space, using 2.5 degrees to 3 degrees or chevron ramp to reach the ground. Another is under the bridge, the relatively stressful places. The vehicle through the escalators on both sides of the U-shaped steel channel to the bicycle lane. Such a design not only provides convenience for the entering and exiting the bridges, but also increases the visual effect of a three-dimensional traffic landscape. Therefore, the bicycle lane landscape constitutes a dynamic, independent, unique three-dimensional traffic space landscape, as a highlight in Xiamen.

Urban Public Transport Function

Xiamen is a city with four seasons of spring and is suitable for public transportation. Through the design of aerial bike lanes landscape, designers not only provide citizens and tourists with a healthy and environmentally friendly way of traveling, but also enrich the types of public transportation in
Xiamen. Most residents choose environment friend public transport, such as BRT bus, bicycles, taxi, bus, subway and so on.

According to the survey, the usage amount of aerial bike lanes during rush hour is twice the normal traffic time, and the bicycle traffic to the BRT station is three times that of normal traffic (as shown in Figure 5). Most people choose aerial bike lanes as their main mode of travel. There are three reasons. Firstly, traffic flow is crowded at peak rush hour and no ordinary bus would be seated. Traffic jams cause physical exertion. Secondly, the longer interval between stations cause inconvenience to the destination especially when staying in the middle of the station. Finally, the choice of aerial bike lanes travel help to improve physical and mental health. They could choose the travel routes according to their own destinations, in line with the concept of green travel values.

![Figure 5. Analysis of bicycle flow in different time periods.](image)

City Night Lighting Function

Many developed countries choose the night view as a landscape resource with potential development. They all believe that a city, day or night, should exude charming charisma and strive to design the most beautiful evening dress [5]. Bike lane landscape lighting at night to provide people a different space experience, to extend the stay time and improve the operational efficiency of three-dimensional traffic space.

In the guardrail on both sides of the aerial bike lanes, a 0.75-meter-long white LED light bar is inserted every 0.3 meters. And when night falls, the lights of the drive lane meander like a city and meander in the city. The light sources on both sides of the lane are shining downwards on the surface of the lane, which not only avoids the direct illumination of the cyclist's eyes, but also increases the recognition of different areas on the ground. The light not only create a good landscape effect but also satisfy the locals’ desire for night-time atmosphere pursuit. Furthermore, improved lighting system help people to provide a good riding space, meet people's travel requirements at night, become a bright spot in Xiamen night (as shown in Figure 6).

![Figure 6. Aerial bicycle lane night light analysis.](image)

Urban Residents Humane Function

Aerial bike lanes landscape with a humane design, has attracted the attention of citizens and tourists. It is mainly represented by three aspects. First of all, the entrances and exits of the lanes adopt the one-car-and-one-brake pattern. At the right side of the gates, there is a prompt screen that provide city weather forecast, temperature, wind direction, humidity and congestion in front. Riders get information through the screen what they want to know. Second, lanes be divided according to different colors of different functional areas: chrome green for the riding area, the gold orange...
buffer zone, titanium blue for the rest area. The rider determine the functional area according to the different colors of the road. Lastly, the designer places the bicycle lane on both sides of the BRT viaduct bridge so that the upper part of the bicycle lane is completely covered by the BRT lane, providing the cyclists with a sheltered riding environment. Through such a humane design approach, it provides urban residents with a good outdoor activity area and a favorite traffic landscape.

**Summary**

People as the main body of urban public space, it is just as the main body to create activities, and activities to strengthen the space, space and further attracted the main body of this activity [6]. Public life is the source of landscape vitality of urban public space. When creating the bicycle lanes, people should be encouraged to choose this healthy and environmentally friendly way of traveling to further attract more people's participation, thus bringing unlimited vitality to the three-dimensional urban traffic space and becoming a beautiful landscape of the city.

The three-dimensional space of urban traffic is a relatively independent ecological system. Its green space is of great significance to improve the regional ecological environment and maintain the sustainable development of the ecosystem. The dense population in residential and commercial areas along bike trails has led to a loss of natural ecosystems. And residents are eager to get close to the city's healthy and environmentally friendly places to travel. As a result, the aerial bike lanes attract the majority of residents to make people enjoy a healthier and more environmentally friendly lifestyle.

In summary, a good urban traffic three-dimensional space design could bring a good visual image to the city, but also improve the people's lifestyle and the city's ecological environment. In the process of designing bicycle lanes in the air, if we could fully combine the two factors of nature and humanity, it could be of great significance to the sustainable development of the 3-D urban traffic system in the future.

**References**