

# Study on Key Design Technique of Guideway Rubber-Tyred System Vehicle Bases Process

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**Abstract:** Taking the Shantang vehicle base of the tourism infrastructure project of Changsha Dawangshan as an example, this paper explores and practices the key technology of the process design, such as the general layout scheme, plant layout, train-washing and inspection facilities, etc. It is expected to provide a reference for the process design of other vehicle bases with the guideway rubber-tyred system.

**Keywords:** Rail Transit; Guideway; Rubber-Tyred System; Vehicle Base; General Layout; Process Design

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## Introduction

With low construction cost, fast construction speed, small environmental impact and easy maintenance, guideway rubber-tyred system is a medium-low transport (passenger) capacity system with broad prospects. It can greatly improve urban transportation efficiency, increase urban efficiency, accelerate development speed, and enhance citizens' travel quality and living standard. <sup>[1]</sup>

According to T/CAMET 00001 — 2020 classification of urban rail transit, guideway rubber-tyred system belongs to a class of urban rail transit system. <sup>[2]</sup> As a new urban rail transit system, only Shenzhen, Hunan, Xi'an and Jiangsu have issued relevant local standards. The standards and guidelines are macroscopic and not refined enough. Therefore, how to determine the general layout of the vehicle base of guideway rubber-tyred system and application facilities are important problems faced by designers.

Changsha Dawangshan tourism infrastructure project is the world's first tourist line using guideway rubber-tyred system. Combined with the design practice of its vehicle base (namely Shantang vehicle base), this paper actively explores and practices the key technology of process design such as the general layout scheme of the vehicle base, plant layout, train-washing and inspection facilities and so on. For this reason, it provides a reference for the process design of similar guideway rubber-tyred system vehicle base.

## 1. Project overview

Changsha Dawangshan tourism infrastructure project is located in Dawangshan tourism resort, Xiangjiang New District, Changsha City, Hunan Province. The starting point is located at Shantang (northern) tourist distribution center, and the ending point is Guanyingang tourist distribution center. The total length of the 8.10km line is made up of guideway rubber-tyred system vehicles, and the whole line is laid on elevated. There are 9 stations in total, and the average station spacing is 0.99km. The whole line has 1 vehicle base, which is located in the plot of Shantang (northern) tourist distribution center. <sup>[3]</sup> It completed and run in May9 2023.

This project will improve the service quality of Dawangshan tourism resort, drive the upgrading of regional tourism industry, and promote the integrated development of Changzhutan urban leisure tourism industry. Shantang vehicle base is a scheduled maintenance depot with a design scale of 1 scheduled and temporary maintenance position, 1 monthly inspection position and 18 parking positions, covering an area of 49176.38m<sup>2</sup> and a total construction area of 16242.48m<sup>2</sup>. <sup>[3]</sup>

## 2. General layout of vehicle base

The general layout of vehicle base is an important part of the process design of vehicle base. The general layout scheme

should be determined according to the site conditions and the surrounding planning roads. The general design principle is to occupy a compact area, smooth process flow, obvious functional zoning, and minimize the cutting of urban land space. [4]

In the design of Shantang vehicle base, based on the characteristics of the general layout of urban rail transit vehicle base, the short length of the vehicles of the guideway rubber-tired system, and the depot in the tourist area and the tense land conditions, so the general layout of vehicle base is determined to adopt the horizontal layout, which is often used in urban rail transit vehicle base, so as to make the depot land compact and reduce the cutting of urban land space. The details are shown in Figure 1.

Shantang vehicle base building on the same site as Shantang (north) tourist distribution center, are located in the northwest part of the plot. Shantang vehicle base is arranged in parallel with Lanshan Road at the end of the line, and the double access line is connected to Shantang Station of the project, which is directly introduced into the comprehensive workshop. The comprehensive workshop consists of a train-washing workshop, a parking garage, a maintenance machinery warehouse, a maintenance workshop and auxiliary rooms for office and production. From north to south, they are arranged in turn as the train-washing workshop, the parking garage, the maintenance machinery warehouse, the maintenance workshop and auxiliary rooms on the south side. Auxiliary rooms of vehicle base include offices, restaurants and so on. The vehicle base has two entrances, one of which is located on Shishan Road and shared with the entrance of cars in the distribution center. The other one is located on Lanshan Road, which is shared with the bus entrance of the distribution center. In the depot, circular road unobstructed, connected to the buildings, not only convenient transportation, but also fully consider the operation and rotation of the fire vehicle. The scheme has compact land, smooth process flow, reasonable building layout and good conditions for the comprehensive development of the surrounding land.

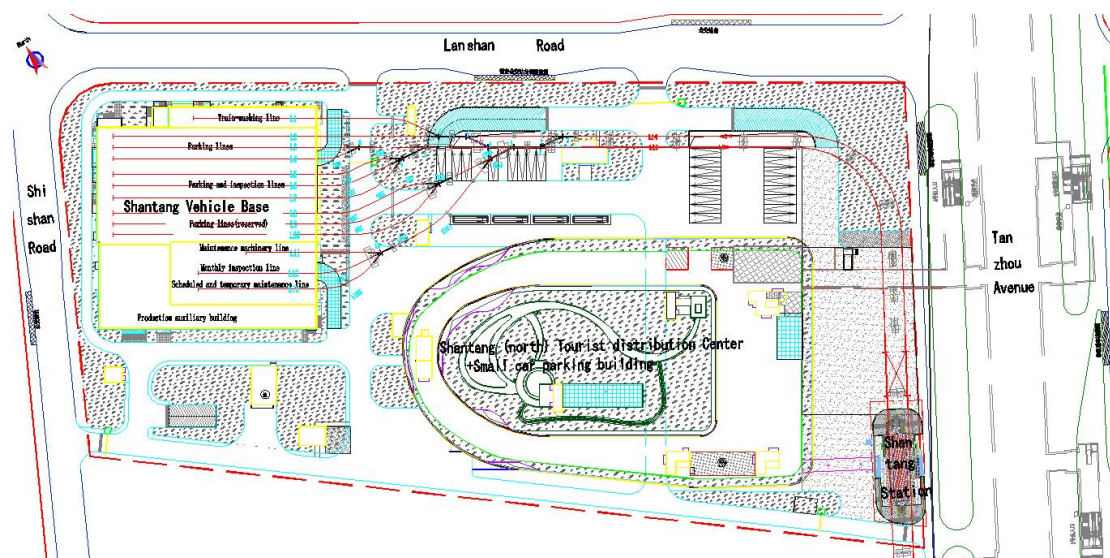


Fig.1 General layout of Shantang vehicle base

### 3. Key technology of vehicle base process design

#### 3.1 Plant layout

The vehicle length of the guideway rubber-tired system is short. The vehicle with 3 modules is 25.6m, which is about equal to the length of one type A metro vehicle, so it is very different from the metro vehicle. In the design of urban tram engineering, there should not be more than 4 trains parked in the stub-end type parking garage. [5] Considering the site conditions and convenient operation, the parking garage adopts 2 trains per line, which makes the operation more convenient.

Shantang vehicle depot conducts plant layout designed with a parking garage and a maintenance workshop as the core. That is, the parking garage is one garage, and the maintenance workshop is built together with scheduled / temporary maintenance and three monthly inspection. The maintenance machinery warehouse is arranged between the parking garage and the maintenance workshop. Train-washing workshop is close to the outside of the parking garage. The train-washing workshop, parking garage, maintenance machinery warehouse, maintenance workshop are connected behind them to form a

joint workshop type. The three monthly inspection is set in the maintenance workshop, mainly considering that it is conducive to creating conditions for balanced repair in the future together with the scheduled maintenance. Meanwhile, the scheduled / temporary maintenance workshop is equipped with a crane and a lifting jack system, so as to realize the sharing and utilization of the auxiliary maintenance production. This plant layout is designed according to the project site conditions, vehicle characteristics, and the design principle of saving land, energy and materials.

### 3.2 Train-washing

The train-washing operation mode is to adopt a fixed train-washing machine and through-type train at the metro depot, and the length of the train-washing workshop is not less than 48m according to the requirements of the train-washing machine. [6] In Dawangshan project, if it was adopted the train-washing operation mode of the metro depot, the vehicle length of the guideway rubber-tyred system is 25.6m, and the safety distance of 10m is increased by considering the stub-end type train-washing line. The effective length of the train-washing line is 109.2m, and the site length is insufficient. The train-washing machine moving, the train stationary parked in the cleaning position of the train-washing operation, mobile train-washing machine through the gantry frame integrated walking system, brush group system, water supply spraying system (including detergent) and blowing water system, along the direction of the train length is only 5m, greatly shortening the length of the train-washing line.

Mobile train-washing machine's cleaning operation process: (1) The train into the train-washing line cleaning position; (2) The train-washing machine receives the train-washing instruction and starts; (3) The train-washing machine move, pre-wet the train and spray detergent; (4) The train-washing machine stops at the return point to wait for the reaction between the detergent and the stain; (5) The train-washing machine is returned for end washing, side washing, top washing and rinsing; (6) The train-washing machine returns to the starting point and begins to blow; (7) Return to the stop position after the blowing and stop the machine; (8) The train-washing is finished, and the train pulls out of the train-washing line.

In order to ensure the safe and stable operation of the train-washing machine, the height of the train-washing machine should be reduced as far as possible, and the landing floor (ground) should be raised by 0.6m, as shown in Figure 2.

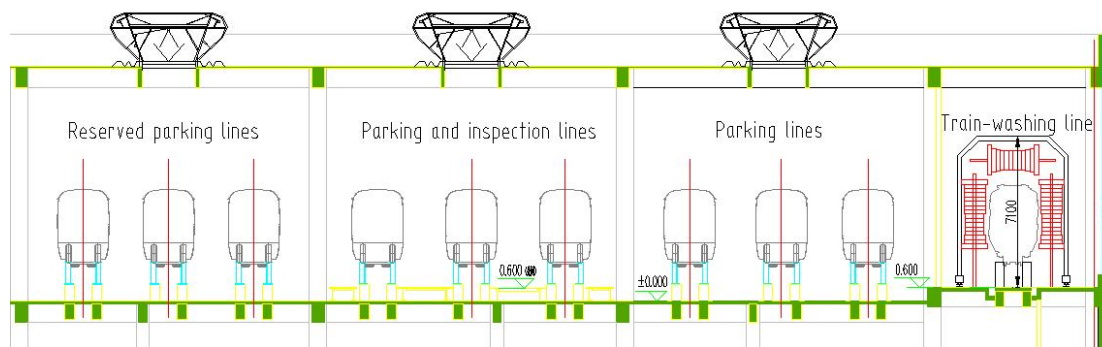


Fig.2 The sectional view of parking garage and train-washing workshop

### 3.3 Parking and inspection

The train inspection operation is generally carried out every day or every two days at the metro depot. The inspection pit is set up at the inspection position to carry out the train running part inspection. In principle, the inspection pit is set up according to the mode of inspection in front and stop behind. The inspection pit shall be the method of earthwork excavation with a depth of 1.3-1.5m. [7]

The train inspection of the guideway rubber-tyred system is weekly inspection. According to the number of long-term assigned 20 trains, minus the number of maintenance 2 trains, 3 inspection positions are set to meet the requirements normally. Considering the development trend of expanding inspection status repair in the future, flexible operation and convenient management, the inspection positions are centrally arranged in combination with the column grid. Six positions of three lines of a span are taken as the inspection positions and the rest are parking positions. Due to the structural characteristics of track beam for the guideway rubber-tyred system vehicle, in order to facilitate the large area of cast-in-situ concrete in the workshop, the elevation of the designed floor (ground) is consistent with that of the inspection pit bottom.

Only the inspection platform is set at the inspection position, appeared at a depth of 1.2 m from the track beam top surface, with the depth of the inspection pit bottom 1.8 m, meeting the requirements of the inspection operation of the guideway rubber-tyred system vehicle. As shown in Figure 2.

#### 4. Conclusion

Taking the Shantang vehicle base of Changsha Dawangshan tourism infrastructure project as an example, this paper describes and studies the key technology of the process design, such as the general layout scheme, plant layout, train-washing and inspection facilities, etc. It is expected to provide a reference for the process design of other vehicle bases with the guideway rubber-tyred system.

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