Layout analysis and optimization design for Zhengding Bus Terminal

Yanwei Li1,a

1College of Transport and Communications, Shanghai Maritime University, Shanghai, China

a)e-mail: 202030610066@stu.shmtu.edu.cn

Abstract: As an important component of road transportation, the bus terminal has always been the focus of research. Therefore, this article uses a combination of quantitative and qualitative analysis to study Zhengding third-level bus terminal from the perspective of layout analysis. On the basis of actual investigation, the relevant indicators of the bus terminal scale are calculated. At the same time, the analysis of the three functional areas and process flow lines inside the passenger station revealed that the passenger station has the problems of intersection of pedestrians and vehicles and the unreasonable and imperfect layout of the ticket waiting hall. Finally, a specific optimization plan is proposed and optimized for the problems existing in Zhengding bus terminal.

1. Introduction
With the rapid development of my country's economy, the process of urbanization in my country is also accelerating step by step, and the flow of people, passengers and goods is also becoming more frequent. Therefore, higher and newer requirements are put forward for the development of road transportation. The problem of mismatch and incoordination with factors such as economic development level, population, and living standards presented by the construction level of the bus terminal as a transportation hub node has become increasingly prominent. In recent years, with the rapid development of Zhengding, the current level of construction of automobile bus terminals has been unable to meet the needs of rapid urban development. From the perspective of long-term planning, it is necessary to properly optimize the layout of Zhengding bus terminal to achieve the goal of avoiding the intersection of pedestrian and vehicle flows, and improving the efficiency of passengers entering and leaving the station and the operating efficiency of the passenger terminal.

2. Current status of bus terminal
The design level of the bus terminal is a three-level bus terminal. It covers an area of about 8,400 square meters, and the ticket waiting hall is about 384 square meters. The station consists of three parts: the square in front of the station, the waiting hall for ticket purchase, and the parking lot in the courtyard. The general layout of the bus terminal is shown in Figure 1, the layout of the ticket waiting hall is shown in Figure 2.
3. Calculation of relevant indicators of Bus Terminal scale

3.1. Design annual average daily passenger volume $F$
According to the document "Classification and Construction Requirements of Automobile Bus Terminals", Zhengding bus terminal is a third-class bus terminal, and its annual average daily passenger volume is planned to be 3,000 people/time.

3.2. Maximum number of passengers gathered $D$
$$D = a \times F$$  \hspace{1cm} (1)

$D$: Maximum number of passengers gathered, person; $F$: Designed annual average daily number of
passengers sent, person-time; a: Calculated percentage. According to F, select the calculated percentage to be 14%.

3.3. Daily departure frequency \( N \)

\[
N = \beta \frac{F(1-\xi)}{\mu} \tag{2}
\]

\( N \): Average daily departure frequency and frequency; \( \beta \): Unbalanced coefficient, generally taken as 1.15; \( \xi \): Passing vehicle ride rate, generally taken as 20%; \( \mu \): Reasonable departure car carrying rate, generally considered as 80%; \( p \): Passenger car the average capacity, people, the average capacity is 29 people.

3.4. Number of stops \( M \)

\[
M = \frac{d(1-\xi)k}{np\mu} \tag{3}
\]

\( K \): additional coefficient, generally taken as 1.2; \( n \): average number of departures per hour during business hours.

| Table 1 Calculation results of relevant indicators of Bus Terminal scale |
|---------------------------|---|---|---|---|
| Related indicators       | F | D | N | M |
| Calculation results      | 3000 | 420 | 119 | 3 |

According to the actual situation of the bus terminal, the number of departures per day is about 150. The planned number of departures is close to the actual number of departures. It can be seen that the current departures basically meet the designed annual average daily passenger volume. At the same time, the bus station has 6 parking spaces, which meet the size requirements of the bus terminal, and can undertake the passenger dispatch task of the bus terminal. Through the above calculation of the scale index data of the bus terminal, it can be found that the station scale of Zhengding bus terminal basically meets the requirements of the original design requirements. However, with the development of the county, the above indicators only have a certain reference value for the current situation.

4. Problems Existing in Bus Terminal and Optimal Design of Layout

4.1. Problems in the bus Terminal

Through on-site investigation of Zhengding bus terminal, the following problems were found in the terminal:

1. Streamlines cross. Passengers, traffic flows outside the bus terminal, and long-distance buses inside the terminal need to pass through the square in front of the terminal, leading to the intersection of the passenger flow and the traffic flow in and out of the terminal.

2. Improper design of the ticket waiting hall. The bus station does not have separate waiting halls and ticket halls, but shares a single ticket waiting hall. This leads to a cross-flow of passengers waiting for bus and buying tickets.

3. The layout of functional areas in the station building is unreasonable. The information desk was blocked by the self-service ticketing platform. There is no toilet in the ticket waiting hall. At the same time, some medical rescue facilities are still lacking in the terminal.

4. There is no boarding platform. The boarding platform is a necessary facility for waiting for checked baggage, and each bus terminal should be set up as required.

4.2. Bus terminal layout design

4.2.1 Optimized ticket waiting hall layout

In the ticket waiting hall, confusion was caused by the queuing to buy tickets and the intersection of waiting people. We can move the entrance and exit, and then install a guardrail with wheels to separate.
the two halls to divide the hall into the ticket hall and the waiting hall. At the same time, set up a public restroom and medical rescue room.

4.2.2 Optimization of parking lot layout
According to the actual situation, it is possible to change the way of vehicles entering and exiting the field, turning the circular entry and exit into a backward parking and forward starting method. At the same time, the saved area is changed to a platform.

4.2.3 Optimization of the square in front of the station
Set up some temporary parking spaces in the square in front of the station and set up stop and go warning signs in the square in front of the station. At the same time, it divides the car passage, bus passage and passenger passage, and builds an overpass at the intersection of the dedicated passenger passage and the passenger entrance and exit passage of the station square platform. The three types of channels are effectively connected without interfering with each other.

5. result

5.1. Results of optimization of ticket waiting hall layout
The ticket waiting hall of the bus terminal has passed the above optimization. The ticket hall and the waiting hall are thus set up separately, and the application of variable guardrails between the two halls has significantly improved the space utilization. At the same time, service facilities such as toilets and medical rescue rooms have been added to solve a series of unexpected problems faced by passengers to a certain extent. The layout optimization of the ticket waiting hall is shown in Figure 3.

5.2. Results of parking lot layout optimization
Before the optimization, a large area of the parking lot of Zhengding bus terminal was occupied by roads. In view of the status quo that the parking station cannot be expanded. After optimization, some roads were converted to platforms, and some roads were used for vehicles entering and exiting the station to switch directions, taking into account the convenience of vehicles entering and leaving the station and
5.3. Optimization results of the square in front of the terminal
This optimization of the streamline comprehensively considers multiple aspects. The optimization of the square provides an optimization plan for setting up dedicated passenger access channels, car access channels, and bus access channels. The dedicated passenger channels and bus access channels intersect at the station square platform. Build overpasses everywhere, so that the three types of channels are effectively connected without interfering with each other, and the flow lines become clear. The overall layout optimization diagram is shown in Figure 4.

![Overall layout optimization diagram](image)

### 6. Conclusion
This article is mainly based on a field survey of Zhengding County's bus terminal, collecting and sorting out the data needed for the layout analysis and optimization of Zhengding County's bus terminal. The mathematical operation and analysis are carried out by combining quantitative and qualitative analysis. On this basis, based on the current situation of the Bus Terminal and the principle of economic adaptability, the layout optimization design of the Bus Terminal is carried out. Thereby improving the passenger service level of Zhengding Bus Terminal.

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