



Research on Comprehensive Development Mode and Technical Path of Bus Station

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Abstract. Under the urban development background of giving priority to the development of public transport, the comprehensive development of bus stations will become an effective means to alleviate traffic congestion, improve land use efficiency and promote urban economic development. However, the current comprehensive development of bus stations generally lags behind, the construction form is single, and the station resources are not effectively utilized. This paper analyzes and summarizes the suitability of comprehensive development of different types of bus stations by classifying bus stations. Based on the classification of bus stops, the comprehensive development is divided into two aspects: spatial layout and functional types, and the suitable development modes of different types of bus stops are summarized. Finally, a practical technical path for the comprehensive development of bus stops is put forward.

Keywords: bus station · comprehensive development · spatial layout · functional type · technical path

1 Introduction

With the popularization of cars and the acceleration of urbanization, the problem of traffic congestion has become increasingly prominent [1, 2]. Giving priority to the development of public transport has become an inevitable choice for urban development. As an important part of urban public transport system, bus stations are places for vehicle parking, operation scheduling, management and maintenance, and provide passengers with boarding and alighting, waiting, transfer and other services [3–5]. They usually cover a large area and are located in a good location of the city. At present, most bus stations in China adopt plane layout with single function, and the land resources of stations are not fully utilized [6]. Under the realistic background of increasing shortage of land resources, the comprehensive development of bus stations has become an effective means to improve land use efficiency [7]. At present, there are many researches and experiences on the comprehensive development of rail transit stations in China, while there are few researches on the development mode and technical path of bus stations, and only a few cities try.

Therefore, this paper refers to the comprehensive development research of rail transit stations, combined with the actual comprehensive development experience of bus

Table 1. Various modes of transportation and environmental pollution

Bus station classification	Definition	Characteristic	Location
Bus hub	There are many bus lines and the gathering points of different types of public transport modes, and there are a large number of public transport passenger flow transfer stations	Large flow of people and large land occupation	Urban central area
Initial and terminal station	Starting and ending stations of bus lines	There is a certain flow of people and a large difference in the scale of land occupation	Urban fringe location
Stopover station	Except for the starting station and terminal station, the stations set along the bus line	There is less traffic, usually only the platform	Along the bus line
Parking lot	Place for parking operating vehicles	The traffic volume is small and the floor area is determined by the number of parking	Urban fringe location
Maintenance field	A place that provides maintenance services for operating vehicles	There are few people, large floor area, pollution and interference	Urban fringe location

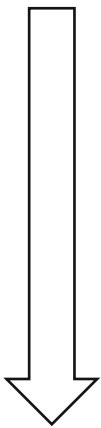
stations, through the classification research of bus stations, analyzes and summarizes the applicable comprehensive development modes for different types of stations, and summarizes the general technical path of comprehensive development of bus stations, hoping to provide practical strategies and ideas for the comprehensive development of bus stations in the future.

2 Classification of Bus Stations and Suitability Analysis of Comprehensive Development

2.1 Bus Station Classification

As the main object of comprehensive development, bus station is the core factor affecting the formulation of comprehensive development strategy. Different types of bus stations cannot be generalized due to the great differences in site scale, architectural form and service function [8]. Therefore, this paper first classifies bus stations as the basis for

Table 2. Various modes of transportation and environmental pollution

Bus station classification	Comprehensive evaluation	Comprehensive Development Suitability
Bus hub	The conditions of people flow, location and scale are the best, which is most suitable for comprehensive development	<div style="text-align: center;">  <p>High</p> <p>Low</p> </div>
Parking lot	The scale of land occupation is determined by the number of parking, and the large-scale is suitable for	
	comprehensive development	
Maintenance field	It covers a large area, but there is pollution. It can be comprehensively developed, but the pollution needs technical treatment	
Initial and terminal station	The scale varies greatly, so it is suitable for comprehensive development when reaching a certain scale	
Stopover station	The floor area is too small for comprehensive development	

the subsequent analysis of comprehensive development strategies of different types of stations. In order to make the classification of public transport stations normative, this paper divides public transport stations into five categories according to the two standard specifications of code for design of urban road public transport stations, yards and plants (CJJ/t15-2011) and code for urban road traffic engineering projects (GB55011-2021), namely, public transport hub stations, initial and terminal stations, stops, parking lots and maintenance yards (Table 1).

2.2 Suitability Analysis of Comprehensive Development of Bus Stations

“Comprehensive development” has a wide range of applications. In this paper, “comprehensive development” refers to the development mode of overall design and construction of one or more of the transportation facilities and commercial, office, residential and other property functions by using the land for bus stations. The advantage of comprehensive development is that while making full use of the traffic accessibility of bus stations, it also improves the land use efficiency of bus stations, so as to improve the land economic value of bus stations. Comprehensively considering the economic benefits and technical feasibility, the location, scale and passenger flow of the station will become the key factors to determine the success of the comprehensive development. Generally speaking, the better the location of the bus station, the larger the scale of the station and the higher the passenger flow of the station, the more suitable for comprehensive development. According to the characteristics of the above bus stations, the development suitability of various bus stations is shown in Table 2.

3 Study on Classification of Comprehensive Development Mode of Bus Stations

The comprehensive development of bus stations can be simplified into different combinations of spatial layout and functional types. The following will first analyze the spatial layout and functional types, and finally analyze and compare several common comprehensive development modes of bus stations.

3.1 Spatial Distribution

The comprehensive development of public transport stations includes public transport facilities and comprehensive development facilities, which generally have three forms in terms of spatial combination, namely plane combination and three-dimensional combination. The combination mode is shown in Fig. 2-1. In addition, the two forms can also be combined to form a comprehensive spatial combination.

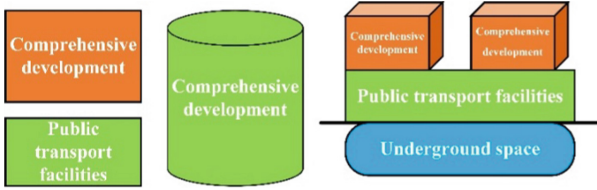


Fig. 1. Schematic diagram of plane combination and three-dimensional combination

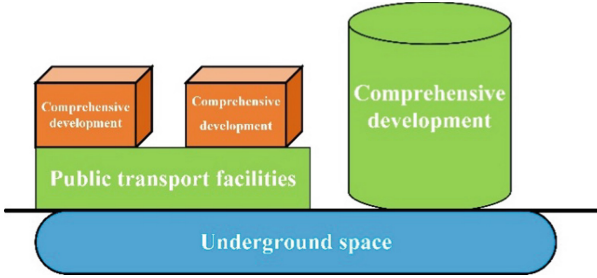


Fig. 2. Schematic diagram of comprehensive combination

4 TOD URT Experiment

4.1 Various Modes of Transportation and Environmental Pollution

At present, the promotion of urbanization has caused many problems. Resource consumption and environmental pollution are one of the problems. It is urgent to accelerate the development and construction of TOD urban rail. In order to prove the advantages of TOD URT development, this paper compares and analyzes energy consumption, carbon dioxide emissions and noise pollution caused by various traffic modes. The results are shown in Fig. 1.

(1) Plane combination

Plane combination refers to the relative separation between comprehensive development and public transport facilities, with clear functional zoning. Under this combination, the public transport facilities are usually located inside the site, and the comprehensive development part is set near the street, and the functions of the two parts do not interfere with each other.

(2) Stereo combination

Three-dimensional combination refers to the three-dimensional development of the site, making full use of the vertical space, and vertically arranging the public transport facilities and the comprehensive development part on the same site, so as to obtain greater land development benefits. Under this combination, the parking lot is usually set in the underground space to meet the requirements of bus parking and comprehensive development parking; The ground floor is bus facilities, and bus transfer is organized; The above public transport facilities are part of comprehensive development.

(3) Comprehensive type

Table 3. Classification and comparison of spatial layout of comprehensive development of bus stations

Category	Plane type	Stereoscopic type
Land use	Decentralized layout and low land use efficiency	Centralized setting, high land use efficiency and high economic benefits
Function combination	Public transport function and comprehensive development function are independent of each other and have little interference with each other	The functions of public transport and comprehensive development are superimposed vertically, and there is some interference between them
Traffic flow organization	Bus flow and comprehensive development traffic flow are set separately, with less mutual interference	There may be interference between public transport vehicles and comprehensive development vehicles
Stream of people organization	Vertical organization of pedestrian flow, convenient transfer and high accessibility of public transport	Plane organization of pedestrian flow, inconvenient transfer and low accessibility of public transport

Comprehensive combination is a spatial layout form combining plane combination and three-dimensional combination. Under this combination, the public transport facilities and the comprehensive development part are set in the functional zoning in the plane space, and there is also the connection of vertical space.

(4) Type summary

Among the three types of spatial combination, the three-dimensional type has high land use efficiency and can be seamlessly connected with the public transport system; Relatively low difficulty in space and plane layout; The comprehensive characteristics are between the two. Generally speaking, the purpose of comprehensive development of bus stations is to improve land use efficiency and increase economic benefits. The plane spatial layout can not achieve the above results. Therefore, on the premise of technical feasibility, it is recommended to adopt three-dimensional or comprehensive spatial layout for the comprehensive development of bus stations (Table 3).

4.2 Function Type

Generally speaking, compared with the comprehensive development of rail transit stations, the development scale and function types of comprehensive development of bus stations are relatively small. Referring to the mature comprehensive development of rail transit stations, this paper can divide the functions other than public transport into commercial functions, residential functions and business functions.

(1) Business function

Bus stations usually have a stable flow of people, which is very beneficial to commercial development. Combining commercial functions with stations can form a commercial

service center with bus stations as the core to guide community bus travel. The development of small-scale shops or shopping centers can be based on the location and scale of shopping centers and commercial stations in the neighborhood. The layout of the hotel is similar to that of the business, but different from the residential function. Therefore, the hotel function is classified into the commercial function.

(2) Residential function

Bus stations have convenient public transportation conditions. The combination of bus stations and residential functions can provide convenient transportation conditions for residents and solve the problem of “the last kilometer”. However, compared with conventional residential land, bus stations are affected by public transportation and have certain noise and air pollution. Therefore, the residential function of bus stations is more suitable for the development of affordable housing and talent apartments, because such residents are more dependent on public transportation and more sensitive to housing prices.

(3) Business function

The bus station has convenient bus and parking conditions, which can solve the commuting problem of business personnel. In this mode, through reasonable traffic streamline design, the seamless connection between traffic stations and destinations can be realized. According to the scale of the bus station and the service objects, the business functions of the comprehensive development of the bus station are mostly in the form of comprehensive office buildings or multi-storey office buildings.

In addition to the above three common urban functions, in practical operation, it is more common to combine the bus station with the above functions for compound development, and the proportion of several types is determined according to the actual needs of the project.

4.3 Function Type

In the actual project application, the comprehensive development of bus stations may be a complex combination of a variety of spatial layout and urban functions, but its basic form will not be separated from the above analysis content, and it should be handled flexibly in specific operation.

5 Technical Path of Comprehensive Development of Bus Stations

Technical feasibility and economic feasibility should be comprehensively considered in the comprehensive development of bus stations. For different bus stations, their development modes are also different, but the technical path of comprehensive development can be summarized. It is hoped that the technical path shown in the figure below can provide ideas for the preliminary research on the comprehensive development of bus stations in various places (Fig. 3).

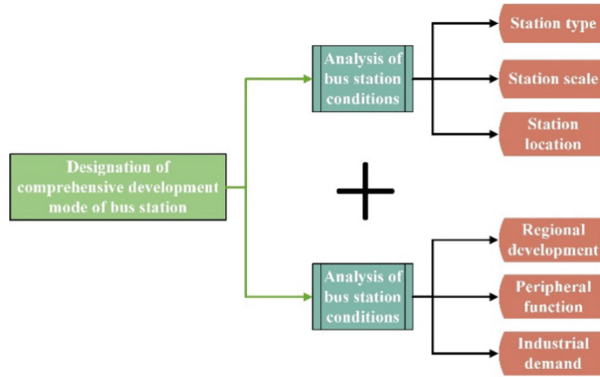


Fig. 3. Technical path of comprehensive development of bus stations

6 Conclusions

Under the realistic background of giving priority to the development of public transport and increasing shortage of land resources, the comprehensive development of bus stations has become the inevitable way for the development of bus stations in the future. Its content involves many fields such as transportation, land use, industry, construction, investment and financing, operation and so on. It is a complex system engineering. This paper chooses to return to the research starting point of comprehensive development, classify bus stations, analyze the suitability of comprehensive development of various stations, summarize the basic spatial layout and functional types of comprehensive development of bus stations, and put forward the technical path of comprehensive development mode research, hoping to provide ideas and references for the formulation of comprehensive development mode of bus stations in the future.

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