

Research on Parking Facility Planning Based on Zoning: A Case Study of Meishan Main Urban Area

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Abstract

"Chaotic parking and difficult parking", cause the problems such as traffic congestion, has plagued cities. In order to solve the parking problem, this paper adopts a partitioned approach to conduct parking facilities planning research. Parking partitions are divided into three types of areas: one type of area restricts supply areas(Type I), restricts the scale of parking facilities, and promotes public transport travel; the second type of area balanced supply areas(Type II), both attach great importance to the construction of parking facilities, and at the same time strengthen the construction of public parking facilities; the three types of areas expand the supply area(Type III), with the construction of parking facilities as the leading factor, and the supply is moderately ahead. This article takes the parking facility planning of Meishan city center as an example, divides parking zones according to traffic districts, urban functional areas, etc., predicts parking demand, adopts supply and demand coordination, and regional differentiation strategies to formulate parking facility plans for this area.

Keywords

Parking zoning; Parking demand forecasting; Parking facility planning.

1. Introduction

With the rapid increase in the number of motor vehicles nowadays, urban road traffic is under greater pressure. There is a lack of allocated parking spaces in the urban area, the contradiction between the supply and demand of parking is becoming more and more serious, and the problems of traffic congestion caused by "chaotic parking and difficult parking" are caused. The National Development and Reform Commission's "Work Points and Tasks for Accelerating the Construction of Urban Parking Lots in the Near Future" also requires that "Special Planning for Parking Facilities" be prepared as soon as possible. Pay attention to the benign and sustainable development of parking, improve the quality of life of residents and urban livability [1].

Urban parking planning is the foundation of parking facility construction, and it is necessary to give full play to the public policy-oriented role of "planning first" in building urban parking facilities and solving urban parking problems. There are also many parking facility specifications and related research, and there are currently parking facility planning studies based on traffic districts and plots [2]. The basic idea of parking facility planning: 1) Supply and demand coordination for supply and demand; 2) Regional differentiation. This article combines theory and practice, taking the parking facility planning of Meishan City as an example.

Meishan City is located in the southwest of the Chengdu Plain in the Sichuan Basin, close to Chengdu in the north, Leshan in the south, and a prefecture-level city close to the urban area of Chengdu. It is

located in the half-hour economic circle of Chengdu and is an important node on the development axis of the Chengdu metropolitan area. According to the statistics of the Meishan City Statistical Yearbook and the vehicle management office, the planned base year of Meishan City's main city has 98,300 cars, and the car ownership rate per thousand people is 195 cars per thousand people. In the field parking research, many problems such as unauthorized parking on the road, diversion of parking lots for other areas, and insufficient parking supply in some areas were found.

Based on the study of parking facilities in different areas, this article refines and resolves the actual parking problem in the main urban area of Meishan City, promotes the benign and sustainable development of parking, and improves the quality of life of residents and the livability of cities.

2. Parking zone division

Comprehensive consideration of population, land, transportation and other factors[3], rationally delineate parking zones and determine differentiated parking development policies, parking facility supply and management strategies.

2.1 Purpose of parking zoning

(1) By dividing parking zones and allocating transportation resources reasonably, parking resources can be shared and used efficiently. Finally, the parking development concept of static braking and dynamic and static coordination is realized to form an integrated, economical and efficient comprehensive transportation system.

(2) By dividing parking zones and coordinating the relationship between parking and land use, the land development and travel modes in different areas can be reasonably allocated to provide support for the use of land in different areas, and guide cars and public transportation to play their respective roles in different areas. Promote social harmony.

(3) By dividing parking zones, formulate and implement differentiated parking development policies, differentiated parking facility supply strategies and differentiated parking management and operation measures for different areas, provide differentiated parking services to facilitate transportation organization and management.

2.2 Principle of parking area division

Adjacent districts are differentiated, coordinated with urban functional areas, coordinated with urban traffic districts[3], and have clear boundaries to facilitate supporting planning and management.

2.3 Control strategy of parking zone

Regarding parking issues, it is necessary to change the traditional concept of blindly providing parking supply is not a benign development. Adjusting the parking supply and demand relationship, through price differences and appropriate introduction of shared parking spaces and other strategies, help to increase the utilization rate of parking spaces.

Type I regional parking development policy that restricts supply areas-restricts the size of parking facilities and promotes public transportation. GAO Hongliang, Zhu Xun [4] proposed a free shared parking strategy based on the study of parking lot distribution and parking rules.

Type II regional parking development policy, balanced supply areas-not only attach great importance to the construction of parking facilities, but also strengthen the construction of public parking facilities. Pay full attention to the solution of basic parking spaces and increase the level of public construction and residential building construction; building construction is open to the outside world to meet its parking demand for attracting visiting vehicles, Jiang Yang-sheng, Peng Bo [5] and others are sharing parking On the basis of theory, the demand for mixed-use parking is researched, and based on this, a perfect reference method for parking space allocation indicators is proposed to meet as much parking demand as possible with less parking resources; adjust the charging standards and make full use of price leverage Strategies for regulating parking demand and improving the operating efficiency of various parking facilities.

Type III regional parking development policies to expand the supply area-with the construction of parking facilities as the leading factor, the supply is moderately ahead. Fully meet the growth of basic parking demand, guide car owners to migrate to the periphery of the city; land use prices are relatively low, the implementation of low parking fees, attract parking and transfer, open parking fees and the city center difference and other strategies.

2.4 Guidance of parking facility supply structure

For the "restricted supply" model, while restricting the scale of construction of newly built buildings, the public parking facilities should be appropriately supplemented and constructed according to the planning requirements in the newly developed areas, and the reasonable parking turnover of public parking facilities should be maintained through price levers to ensure the level of parking services. Internal parking berths are mainly used for temporary short-term parking needs such as shopping, savings, postal services, and dining.

For the "balanced supply" model, implement the supply strategy of mainly building facilities, flexibly adjust the ratio of public parking facilities to on-street parking facilities, and strengthen the integration and cooperation between building parking facilities and public parking facilities for social development. Improve the resource utilization rate of parking facilities.

For the "expanded supply" model, the parking berth configuration should be appropriately advanced to fully meet the parking demand. On the premise of ensuring that the building is mainly equipped with parking, the supply ratio of on-street parking facilities should be appropriately increased to improve the utilization rate of road space resources.

2.5 Take Meishan city as an example

The parking zone is based on traffic districts and traffic zones. Traffic zones are understood as urban functional areas, are larger than traffic districts. Refer to the "Meishan City Master Plan" and "Meishan City Comprehensive Transportation System Plan" zones. Schematic diagram of the number of traffic districts in the planning area, dividing Meishan City into 68 traffic districts (Figure 1). Study the detailed control regulations of each district in the main urban area of Meishan City. The main urban area of Meishan City is divided into traffic zones (Figure 2). On this basis, coordination, comprehensive on-the-spot investigations, and division of parking lots (Figure 3)



Figure 1.Meishan Traffic Districts

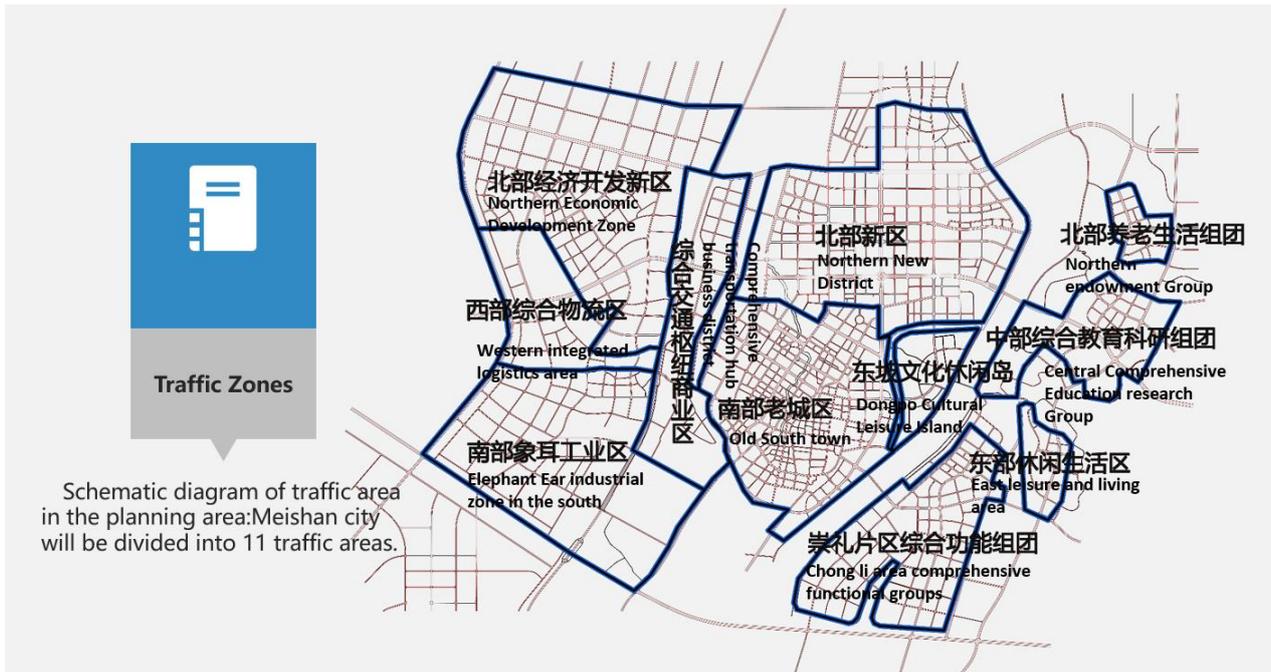


Figure 2. Meishan Traffic Zones

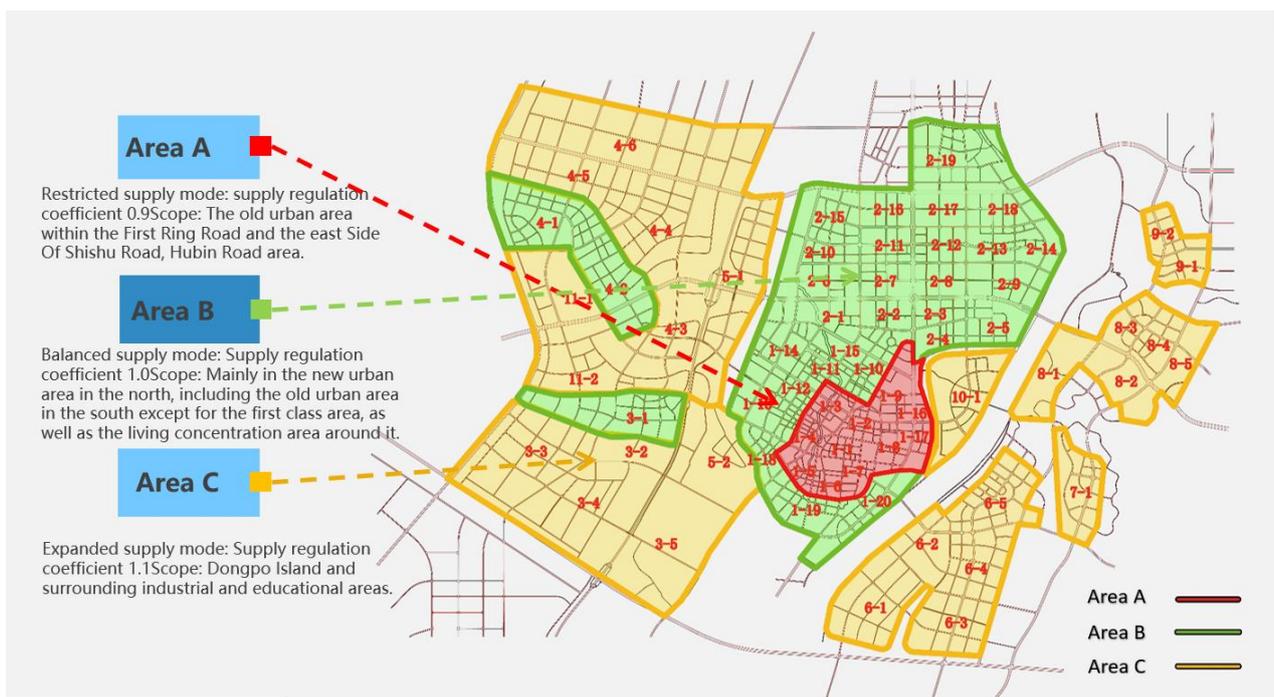


Figure 3. Meishan Parking Zoning plan

According to the characteristics of different parking areas in the main urban area of Meishan, different parking supply and demand relationships, parking facility structure, parking facility management, parking facility management and other regulatory measures are taken to lay the foundation for the analysis of parking facility supply and demand. In general, it can be divided into three modes: "restricted supply", "balanced supply" and "expanded supply". The type I district adopts the "restricted supply" model, the type II district adopts the balanced supply model, and the type III district adopts the "expanded supply" model (Table 1).

Table 1. Meishan Parking Facilities Divisional Supply Table

Partition type	Partition mode	Transportation Development Model	Road traffic conditions	Supply Regulation Factor
Type I	Restricted supply	Public transportation as the main body	Unreasonable structure, limited capacity, obvious traffic congestion	0.9
Type II	Balanced supply	Public transport priority	Reasonable structure, good capacity and smooth traffic	1.0
Type III	Expand supply	Car and bus competition development	Main road network is developed, with sufficient capacity and smooth traffic	1.1

Type I(Area A in Figure 3) Regional parking development policy

Restrict supply areas-limit the scale of parking facilities and promote public transportation. In the old urban area of Meishan City, including the core area of Sansu Temple, the parking standards are low. The commercial, residential and administrative offices in the urban area are seriously lacking. Only the newly built commercial and residential Commercial buildings are equipped with some parking facilities, which make parking difficult and impede normal road traffic.

Type II (Area B in Figure 3) Regional Parking Development Policy

Balanced supply areas-not only attach great importance to the construction of parking facilities, but also strengthen the construction of public parking facilities. It mainly includes the new urban area of Meishan City and the residential functional area on the west side. The construction of the new urban area is relatively late. The road network is mainly based on the grid structure. The primary and secondary trunk roads and branch roads of the entire area form a system and form a preliminary road network. Scale, construction and parking of buildings in the area are built according to the new version of the construction standards implemented after 2012. Some planned commercial areas are still under construction or have just been completed, and there is room for further adjustment and improvement.

Type III(Area C in Figure 3) and Type IV regional parking development policies

Expansion of the supply area-with the construction of parking facilities as the leading factor, the supply is moderately ahead. It is mainly composed of the western industrial development zone, the kimchi city Chongli comprehensive functional area in the east, the university education and scientific research area, and the Dongpo cultural and leisure island. Because of the late development, some areas have not yet formed a complete road network scale and perfect residential use The conditions can therefore be adjusted appropriately according to the prospective urban development forecast and planning.

3. Analysis of parking supply and demand based on parking zoning

Drawing on the common methods of parking forecasting, based on the available data, the population-land forecasting method and the vehicle ownership forecasting method are used to forecast the total amount of parking demand, and the land analysis forecasting method is used to analyze and forecast the parking demand by districts. Carry out mutual check and finally determine the parking scale of each zone. In the process of prediction, it is considered that parking demand is affected by various factors other than land use [6], such as parking development strategy, land use model, road network capacity constraint, vehicle growth level, parking sharing and traffic demand management objectives, etc. The specific forecast values are as follows(Table 2-4):

Table 2. Prediction table of motor Vehicle ownership in the main urban area of Meishan City

Year	Car ownership rate (vehicles/thousand persons)	Car ownership (ten thousand)	Population in the main urban area (ten thousand people)	Average annual growth rate of car ownership
2030	294	25	85	5%

The main factors affecting the urban parking demand are the urban socio-economic development level, urban population, land use structure, productivity layout and the number of motor vehicles, of which the number of motor vehicles has the most significant impact on the parking demand [7].

Table 3. Meishan Parking Demand total forecast table

Forecast year	Population in the main urban area (ten thousand people)	Predicted parking demand (m ²)	Number of parking spaces (number)	Population of Meishan City (ten thousand people)	Predicted parking demand (m ²)	Number of parking spaces in Meishan City (number)
2030	85	884000-1147500	29467-38250	370	3848000~4995000	128267~166500

Table 4. Forecast table of total parking demand in the main urban area of Meishan City

Year	Motor vehicle ownership	Demand for parking spaces	Total demand
2030	250000	75000	325000

Based on comprehensive consideration of the standard and the actual situation, determine the supply ratio of parking facilities in different parking zones(Table5-6):

Table 5. Demand and supply ratio of parking facilities in Meishan City

Partition type	Partition mode	Building parking lot	Off-street public parking	On-street parking
Type I	Restricted supply	74%	19%	7%
Type II	Balanced supply	83%	14%	3%
Type III	Expand supply	90%	9%	1%

Table 6. Prediction table of parking demand in each district of Meishan City

	Total demand	Building parking lot	Off-street public parking	On-street parking
Southern Old Town	94347	74188	15498	4662
Northern New District	91318	75794	12785	2740
Elephant Ear industrial zone in the south	16236	13801	2041	394
Northern Economic Development Zone	33054	27986	4234	834
Comprehensive transportation hub business district	19498	17548	1755	195

Chongli area comprehensive functional groups	28787	25908	2591	288
East leisure and living area	7543	6789	679	75
Central Comprehensive Education research Group	20560	18504	1850	206
Northern endowment Group	6454	5808	581	65
Dongpo Cultural Leisure Island	7203	6483	648	72
Western integrated logistics area	0	0	0	0
Total	325000	272809	42661	9530

Trans CAD is used to make the demand forecast map of parking facilities. Based on the base map of Meishan City, the unit is divided into traffic districts(Figure4).

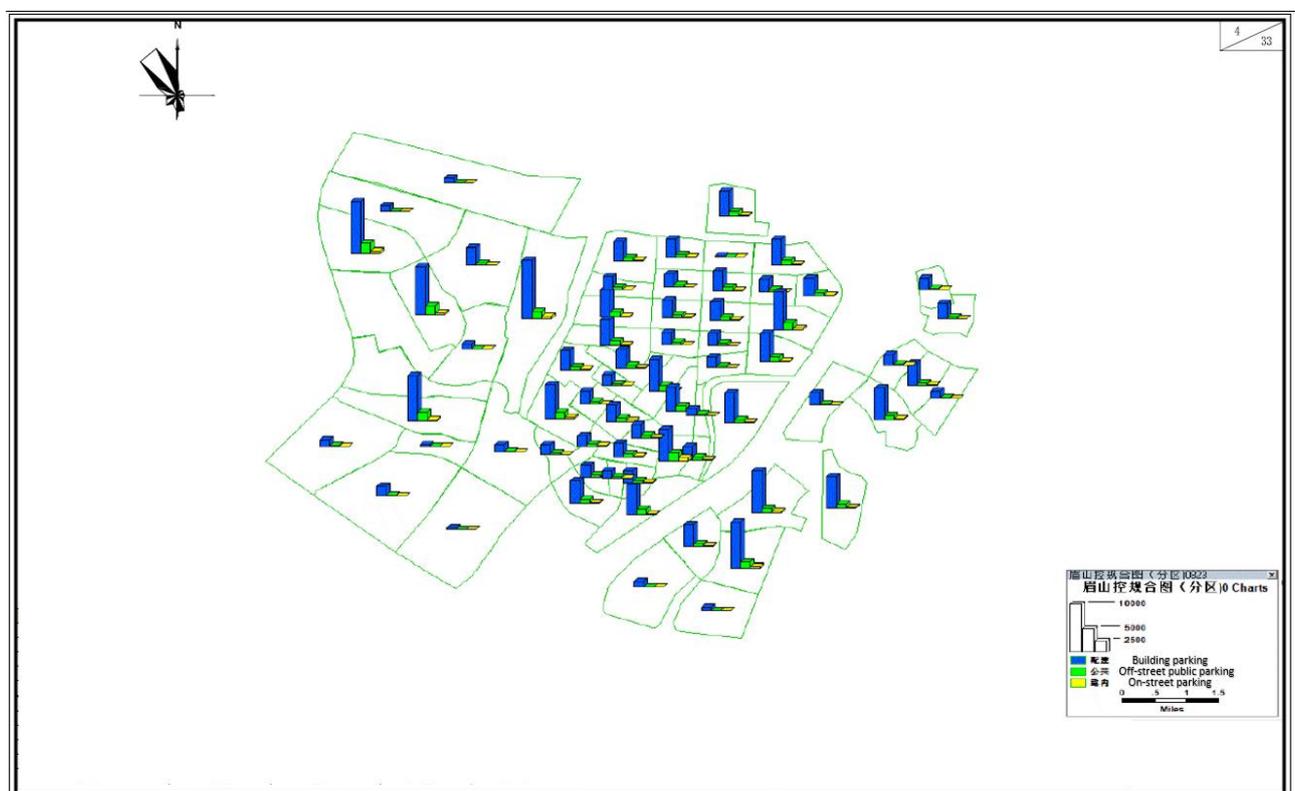


Figure 4 The forecast of parking demand in the main urban area of Meishan City

4. Layout of parking facilities based on parking zones

4.1 General idea

According to the principle of regional differentiation and overall planning of supply and demand for supply and demand. Due to different influencing factors such as population distribution, employment distribution, land use, transportation policy, public transportation development strategy, and road system supply level in different regions of the city, the supply of urban parking facilities should also be targeted to the "differentiated" characteristics of different regions. Different parking zones are divided according to parking development strategies, and the corresponding strategies and requirements of parking facility supply and demand, parking facility supply structure, parking facility

management and operation regulation are proposed. According to the development characteristics of different regions, the total amount and structure of parking facilities in different regions are regulated, and multiple means are used together to manage the demand for parking facilities, so as to adapt traffic demand to supply capacity.

According to the parking concept of "regional differentiation", the analysis of the relevant influencing factors such as the nature and intensity of land use in each zone, the supply level of transportation facilities, the characteristics of traffic operation, and the demand for parking. The corresponding development modes of parking facilities can generally be divided into the following three types:

- ① Restricted development model: limited supply of parking facilities, vigorously develop public transportation, strengthen traffic management, strictly control the development of individual motorized transportation, and suppress parking demand through the supply mechanism and price mechanism, thereby reducing the use of cars.
- ② Moderate development model: Moderate supply of parking facilities, limited to meet parking demand, to meet the needs of moderate motorized development. At the same time, it is also necessary to strengthen the management and operation of parking facilities to guide the rational travel of cars.
- ③ Free development model: supporting the policy of loose use of cars, vigorously strengthening the construction of parking facilities, and the parking supply meets or even meets the demand for parking ahead of schedule.

In the construction of social parking lots and car parking line construction projects, traffic impact assessment should also be considered; differentiated toll areas are implemented; unreasonable on-street parking spaces are eliminated, such as the main roads of expressways and main roads,) intersections, Railway crossings, sharp bends, narrow roads with a width of less than 4m, bridges, steep slopes, tunnels, road sections within 50m from the above points, etc.; on-street parking spaces can be established according to the area and road number, and a corresponding parking guidance system can be established, And can be organically connected with off-street parking guidance system, urban traffic management system, etc. [8-10].

4.2 Overall layout scheme

In this plan, 76 new public parking lots were added, with a total of 44,334 parking lots. Among them, 13 new off-street public parking lots are planned in the near future, and 63 parking lots are planned in the long-term; some unreasonable parking berths are gradually canceled in batches, and 9,530 on-street parking spaces are newly built. Some road sections are subject to commercial concentration and school pick-up. When there is a need for temporary parking on the road, add on-street parking berths based on the actual situation of the road; revise the standard for building parking spaces, re-classify the construction categories of Meishan City, and adjust and formulate the opportunities within each parking zone. Indicators for the allocation of motor vehicles and non-motor vehicles.

Parking fee policy guidance and the introduction of local parking management measures recommend that the toll road be differentiated inside and outside, the toll time difference, and the toll area difference. In the main urban area of Meishan City, parking fees for Type I, Type II, and Type III areas adopt different price ratios, and the principle of "Type I areas are greater than Type II areas, and Type II areas are greater than Type III areas" is adopted to effectively control Type I areas. vehicle.

Solved the problems of long-term parking difficulties, parking chaos, and affecting traffic flow, and improved the refinement and convenience of management.

5. Conclusion

By differentiating and formulating the corresponding parking supply strategy and parking management strategy for the planned parking zones in the parking area, parking facility planning can be more refined and precise. Coordinate supply and demand, give full play to the impact and

restriction of the supply of parking facilities on demand, adjust the supply and demand of parking, and realize the total and dynamic balance of the supply and demand of parking facilities.

From theory to practical application, taking parking facility planning in the main urban area of Meishan as an example, three types of parking zones are divided according to traffic districts, traffic zones, and actual development, and parking facility planning is launched on this basis. According to the development characteristics of different regions, the total amount and structure of parking facilities in different regions are regulated, and multiple means are used together to manage the demand for parking facilities, so as to adapt traffic demand to supply capacity. Avoiding a one-size-fits-all approach makes planning more rational and scientific. Compared with other methods, the parking facility planning method based on districts is more operable and has certain reference significance for the parking facility planning in other cities of the same type.

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