

# A Study Of Time-sharing Smart Parking Strategies In Xi'an Community

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**Abstract.** At present, parking is difficult, expensive and chaotic has become the main bottleneck in the development of urban transport. The key to the problem lies not only in the lack of total parking spaces, but also in the serious waste of existing resources, resulting in a structural imbalance of 'parking difficulties on one side and idle parking spaces on the other'. The report of the 20th Party Congress proposes to build a livable, resilient and smart city. As the largest hub city in the west, Xi'an is facing traffic congestion and inconvenient walking while developing rapidly. With the economic acceleration, urban expansion and travelling demand growth, parking conflicts are becoming more and more prominent and need to be solved urgently. Based on the actual situation, this paper takes Dongmutoushi Area in Beilin District of Xi'an as the research object, and proposes the countermeasures of shared parking to alleviate traffic congestion, optimise the walking environment, and enhance the travel efficiency through data analysis and field research. Drawing on successful cases and combining the current situation and problems in the area, the study proposes three major strategies: first, to put forward the evaluation standard of 'space-time sharing integratio'; second, to classify the internal space of the community, formulate a transformation plan and clarify the scope of sharing; third, to build a time-sharing platform to promote the staggered sharing of community and social parking spaces, and to create a scientific and orderly sharing environment. Thirdly, we will build a time-sharing platform to promote the staggered sharing of community and social parking spaces, create a scientific and orderly sharing environment, improve the acceptance of residents, help the construction of smart cities, tap the potential of parking resources, ease traffic congestion and promote the creation of civilised cities.

**Keywords:** shared car parking; sharing integration; spatio-temporal strategy; spatio-temporal sharing integration rating system; smart parking.

## 1. Introduction

### 1.1 Research background

Accompanied by China's motorisation and urbanisation process accelerated and the level of road construction improved, the national motor vehicle ownership was 'blowout' type growth, the corresponding parking demand also increased. With the development of motorisation corresponding to the lack of parking infrastructure, the management level has not been improved accordingly, resulting in parking space supply and demand contradictions are becoming more and more prominent[1], which triggered a series of negative chain reactions, such as occupied parking and cruising to find a parking space resulting in a decline in the capacity of the road, the residents of the daily travel of the high efficiency and comfort can not be guaranteed, the driver's emotional anxiety and thus lead to accidents, as well as queuing resulting in energy consumption and environmental pollution problems. Energy consumption and environmental pollution problems caused by queuing[2]. In order to meet the parking needs of social vehicle owners, urban transport hubs, cultural and sports, commercial, medical and office buildings such as parking facilities are constantly increasing the scale of construction, construction standards continue to improve, but parking congestion phenomenon has not yet been significantly improved, parking is difficult to park, parking is expensive and parking problem has become a constraint on the development of the shackles of the urban traffic. However, the crux of the problem of 'parking difficulties' is not only because of the existence of parking gap, the waste of existing parking resources is also another major key cause[3]. Allocation of car parks for each type of land, except for the peak period of time

parking space idle rate is high, resulting in ‘one side of the parking difficulties, the other side of the parking space idle’ structural imbalance.

In view of the existing traffic problems, it is proposed to construct a community spatial and temporal shared parking system under the perspective of smart city, which relies on improving the utilisation rate of the existing parking spaces to alleviate the urban traffic situation. The concept of sharing has been widely favoured by the public since its introduction[4], and the coverage of the sharing model has become wider and wider, and the scale is also expanding. Innovations such as bike sharing and car sharing have brought a lot of convenience to the lives of our residents[5], and at the same time, they have also achieved an effective attempt to rationally utilise the idle resources of the society. In order to revitalise parking resources, this time, through researching the parking situation and the distribution of parking resources in established communities in Xi'an, Shaanxi Province, a representative city of Northwest China, to explore the conditions and ways of implementing shared parking at the spatial and temporal levels, so as to construct the concept of a smart parking system[6], a framework model, and the idea of on-line and off-line docking, and finally, to integrate the problems uncovered and the direction of exploration into a smart parking system. The system takes social car owners as the target users and helps them solve the problems of difficult, expensive and chaotic parking.

## 1.2 Summary of the study

The research includes the following aspects:

(1) Theoretical analysis. To understand the relevant theoretical knowledge about shared parking, and to provide a comprehensive summary and in-depth analysis of the relevant theories of shared parking.

(2) Field research. Combine with the actual specific cases for comprehensive analysis, comprehensively grasp the current background information of the base, and point out the existing problems.

(3) Methodological summary. Summarise the planning and design methods, procedures and theories of shared parking.

(4) Case study. Through theoretical research and case study analysis, new design methods and design ideas are derived.

## 1.3 Significance of the study

Accelerated urbanization: With the acceleration of urbanization, parking difficulties have become an important issue in urban governance. Shared parking, as an effective solution, has now received great attention from academia, industry and government[7]. However, most of the current research and implementation on shared parking is in the primary stage, and some important practical issues need to be further deepened. This paper, by combining its own knowledge, based on the investigation of the current situation of community parking in Xi'an, can be promoted to a wider extent by establishing a scientific and orderly parking space-sharing environment and management mechanism, and by improving the acceptance and recognition of residents' parking space-sharing. The implementation of parking space sharing in existing communities. It has certain reference and reference significance for the development of future management strategy of parking space sharing in existing communities, and at the same time, it is of great significance for the promotion of sustainable development of the city, maintaining the vitality and charm of the city, upgrading the quality of the urban transportation environment, solving the problem of the utilization of social idle resources, and improving the efficiency of the social operation.

## 2. Research Objects And Related Concepts

### 2.1 Subjects

The main research object to be studied in this paper is urban parking lots. Through the comparative analysis of the actual cases, the Dongmutou City area of Beilin District, Xi'an City was selected, the current conditions were sorted out and analyzed after field investigation, and the existing problems and optimization countermeasures were put forward in combination with the existing theories and cases, and the appropriate design strategies were studied to make effective use of the space.

The main purpose of the parking lot is to ensure the rapidity and continuity of urban road traffic, reduce traffic congestion, improve road use efficiency. With the continuous acceleration of urbanization development process, the scale of Xi'an is getting bigger and bigger and the population is more and more, the travel of a large number of people has become the problem that urban planning work faces, so the demand for parking spaces is also getting bigger and bigger, and it is difficult to realize the travel of a large number of people only by virtue of the existing parking facilities in the city. By integrating the parking resources of urban China, shared parking can improve the utilization rate of parking spaces[8], the contradiction between supply and demand of parking, and bring additional income to parking spaces (see Figures 2-1 ).



Fig. 2-1. Parking guidance screen

### 2.2 Definition of related concepts

#### (1) Sharing parking

Sharing parking refers to the difference in space and time that the parking has by utilizing the difference in space and time of different land use properties, rational utilization of resources, a parking space is used in different times of the day according to the time peak use difference and is allocated to a plurality of cars.

#### (2) parking space

Parking space refers to the indoor or outdoor space that has diversified functions such as vehicle parking, repair service, refueling and inflatable, leisure landscape, is used for people to park and use, and the main space form has parking lot, parking building, parking garage and the like.

#### (3) Shared bonding

Shared Coupling' specifically refers to the high strength dependencies of multiple parking system modules or components through direct access and modification of the same globally shared data resource.

## 3. Current Situation

The research base is Dongmutou City, East Street, Xi'an City, north to East Street, west to South Street, east to Duanzhimen, and the research area is Kaiyuan Parking Lot, Xingzhengyuan Parking Lot, Calico Garden Community, Lido Famous Garden, Dongmutou City Family Hospital, etc.

Dongmutou City is located in the bell tower business district, wherein the construction of the old community is located in the location conditions have considerable advantages, but due to the neglect of the transformation of the old community in recent years, the development situation is very backward, traffic congestion, the problem of lack of parking space emerges in endlessly. Due to the surrounding commercial complexes, office complexes are more, the phenomenon of foreign vehicles occupying on-road and off-road parking spaces at will is also very serious.

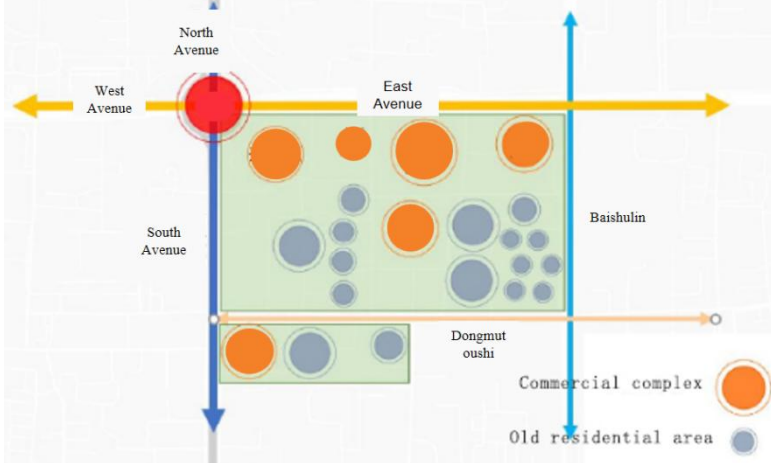


Fig. 3-1. Location map of Dongmutou urban area

### 3.1 Serious illegal parking

Since Dongmutou City is located in the Zhonglou business district, there is no doubt that there are a large number of vehicle parking problems. And because of the construction of more old communities, the early planning of parking facilities is quite lacking, resulting in illegal parking, road congestion problems are serious[10]. The road is very narrow, and if a car is parked on a street, the subsequent vehicles entering the road will have different congestion problems. Moreover, the building density is large, and the land area that can be left for the construction of the parking lot is very narrow. In the preliminary investigation, it was found that there were illegally parked vehicles on almost every road, as shown in Figure 3-2.

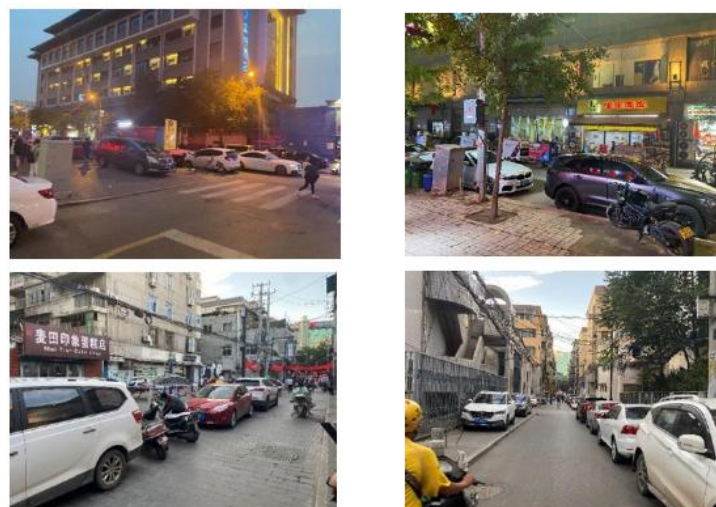


Fig. 3-2. Motor vehicle parking violations

### 3.2 Parking facilities are relatively inadequate

The old community of Dongmutou City is very backward due to the reason that the early planning is not enough to consider, and the parking facilities in each community are quite scarce, so

that there is almost none, so it causes the illegal behavior that a large number of cars are parked on the side of the road or are parked at will in the community. Moreover, most of the old communities in Dongmutou City occupy a small area[11], and most of them are old-fashioned buildings, and the free area in front of each building is very small. The difficulty of carrying out parking space or road reconstruction in the residential area again is higher, and the cost is also larger, and the new residential area also has the situation that parking facilities are imperfect due to the reason of land shortage, as shown in Figure 3-3.

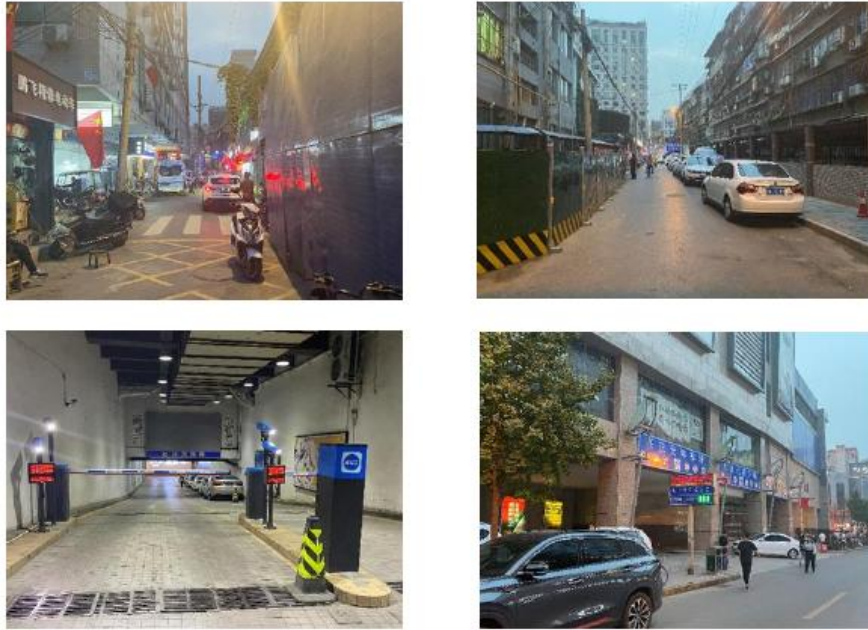


Fig. 3-3. Parking inside and outside residential areas

### 3.3 There is a large amount of vacant parking spaces in the surrounding commercial parking lots

There are many complexes in Dongmutou City, such as Kaiyuan Shopping Mall, Xingzhengyuan Plaza, Yunlong Building, Gemdale Building and other commercial and office facilities built around. Most of these facilities have built-up parking lots. According to the survey statistics, there are about 990 parking spaces in the parking lot in the whole area, which can meet the needs of surrounding users, as shown in Figure 3-4. For the area, the large number of commercial, office and entertainment venues results in a higher demand for parking during the day than at night[12].

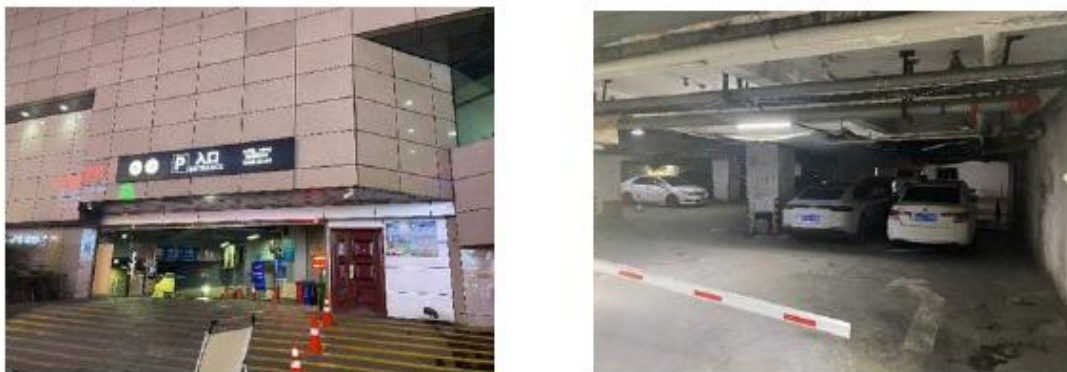


Fig. 3-4. Underground parking is available

### 3.4 Low level of parking management informatization

Through preliminary investigation, it was found that the infrastructure construction of Dongmutou City is insufficient[13], so there are basically no guidance facilities such as parking lot indication signs. The parking lot signs of large commercial complexes such as Kaiyuan Mall and Xingzhengyuan Plaza show that the number of remaining parking spaces does not match the actual number of statistics. Due to problems such as road congestion, illegal parking, car owners will waste time when driving in or leaving, so that the vehicle is parked in the middle of the road in order to wait for a parking space, as shown in Figure 3-5.



Fig. 3-5. The level of informatization of parking management is low

### 3.5 Parking Fees Are High

Due to the existence of a plurality of large commercial complexes in East Mutou City, the overall parking charges are mostly high[14], and the parking fees within the community are more reasonable but the number of parking spaces is very small, and most of the car owners who do not have the parking spaces in the community are still willing to park their vehicles on the road. The supervision of the disorderly parking behavior on the road is insufficient, and both sides of the road have become the free parking lot of the car owners of the community, causing serious traffic congestion problem, and the efficiency of parking in the road is greatly reduced. Therefore, Dongmutou City needs to regulate the parking price through economic leverage in the aspect of parking charges, so that more people can have reasonable parking options, and at the same time, the reasonable price will also bring more development opportunities to the construction of parking lots in the area.

## 4. Case

### 4.1 Case Study

Through in-depth research, Xi'an, although the parking supply and demand contradiction is acute, but the parking lot use of busy and uneven, there are a large number of parking resources in part of the time idle waste phenomenon. In order to effectively manage the existing parking resources, improve the efficiency of parking utilization, thereby effectively alleviating the parking problem, the implementation of the parking sharing concept, with the help of information technology, and actively carry out parking guidance, resource sharing, space-time shift exploration, the main measures include:

(1) Parking induction, guiding vehicles to park nearby;

Xi'an Municipal Construction Commission has built the Xi'an Smart Parking Information Platform[15], which has effectively integrated information of 86,000 parking spaces in 1,389 parking lots, and realized data sharing between the platform and Xi'an Traffic Police Command Center, laying a data foundation for the realization of smart parking management.

Xi'an Traffic Police Command Center can grasp the real-time distribution of parking spaces, free status, vehicle access information, relying on the "Xi'an Traffic Police" WeChat service number and APP to provide accurate parking guidance services for drivers, the public can view the nearby

parking spots and vacant parking spaces, through the online navigation function provided by the service to quickly arrive at the parking spot, reverse check the car and pay parking fees online. and pay parking fees online. At the same time, 76 three-stage parking guidance screens in the city release real-time parking space information, guide vehicles to park nearby, and promote the maximum utilization of parking space resources.

In order to guide the public green travel, Xi'an Traffic Police also cooperated with Xi'an Motor Vehicle Parking Service Center to launch a new energy vehicle free parking service for two hours. Xi'an new energy vehicles can apply for the service online through the "Xi'an Traffic Police" WeChat service number and APP, and after passing the audit, you can enjoy free parking for two hours each time within the jurisdiction of the Motor Vehicle Parking Service Center within the scope of the public parking lot, and you can also find nearby charging piles (stations) through the two modes of the closest distance and the lowest cost.

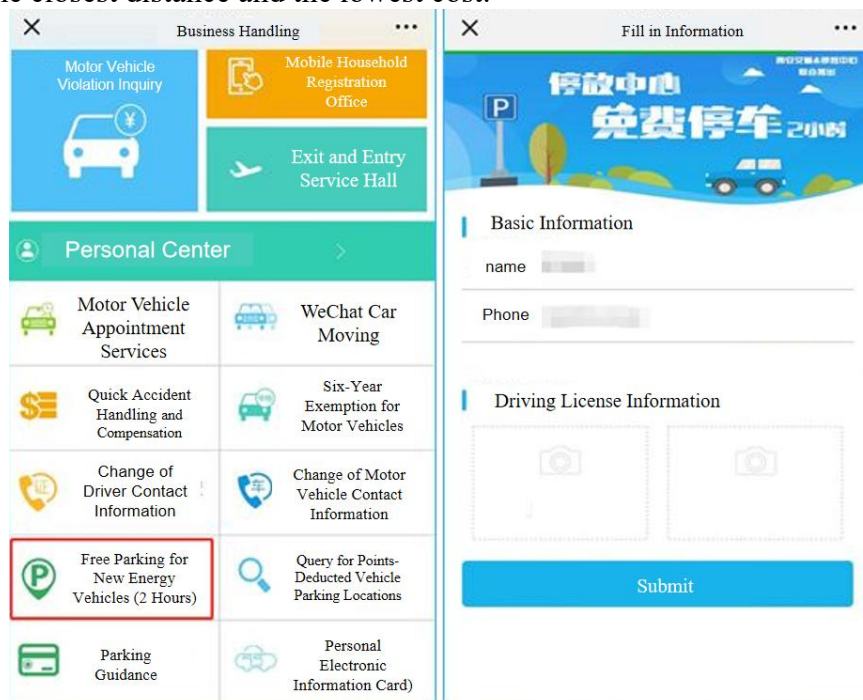


Fig. 4-1. Free 2-hour parking for new energy vehicles

(2) Staggered sharing of parking resources to alleviate parking difficulties around business districts

Aiming at the characteristics of different parking demands between commercial areas and residential areas, staggered sharing of parking lots in commercial areas and residential areas is implemented to solve the parking problems of commercial and residential areas[16].

(3) Space Mobilization+Intelligent Parking Guidance to Relieve Parking Difficulties around Hospitals

For a long time, the contradiction between parking supply and demand around hospitals is generally prominent. Take Xi'an Children's Hospital as an example, the hospital is the most authoritative pediatric hospital in five provinces in northwest China and is located in the west gate of the old city, and the contradiction between parking supply and demand around the hospital is very prominent, with limited on-street parking resources, and the indiscriminate parking of vehicles for medical treatment often results in congestion and affects the travel of residents, and the residents of surrounding neighborhoods also have strong parking demand. In order to solve the contradiction between the supply and demand of medical parking, Xi'an traffic police joint hospitals, communities, within and outside the move, and constantly tap the potential of parking resources[17], so that the hospital and its surrounding supply of medical parking spaces to enhance 9 times, the hospital area vehicle traffic efficiency by 20%, medical vehicle queuing time savings of 12 minutes,

the masses 5% satisfaction, to achieve a win-win situation for the patient, the hospital, the community, the masses, the traffic police.

#### 4.2 Advantages, Disadvantages and Applicable Conditions

Through the Internet platform, the shared parking mode shares the parking spaces owned by individuals or enterprises and provides them to users with parking demand, realizing the optimized allocation of parking resources. And by taking advantage of the differences in parking demand in different areas at different time periods, it realizes the staggered use of parking spaces and improves the utilization rate of parking spaces.

However, the parking resources integrated by shared parking enterprises are limited and often confined to specific areas, resulting in a poor experience and difficulty in forming a scale effect. The shared parking industry has not yet formed a complete industry standard, and laws, regulations and regulatory policies are lagging behind, leading to chaotic market order and a lack of security for user privacy and payment data. In practice, it is necessary to communicate and coordinate with community properties and units, which may have reservations about opening up shared parking resources due to security considerations or management complexity.

### 5. Improvement Strategies

#### 5.1 Establishment of the Shared Integration Degree Model

Based on the shared space relationship between other functional spaces and parking spaces within the residential area, combined with the degree of shared integration[18], a hierarchical analysis model is constructed according to the functionality, openness, shape rate, accessibility, privacy and the following nine indicators of the space, and various types of spaces are scored and classified, mainly forming three types of Shared Integration Degree spaces, and respectively tapping the potential of the universal transformation strategies for each main classification. Taking the three renovation schemes of ground parking spaces, underground parking spaces and stereo garages as the final effect, reasonable parking space renovation planning is carried out for various spaces.

##### 5.1.1 Construction of the Shared Integration Degree Model

A consultation questionnaire for the evaluation system of shared parking matching was constructed, and university teachers majoring in urban transportation planning, urban transportation management personnel, doctoral and master students majoring in urban transportation planning, and other professionals in the parking field, as well as experts in need of consultation, were invited to fill out the questionnaire. Then, based on the judgment results of professionals, the relative weights of each factor under a single criterion. The relative importance weights of each factor in the indicator layer to the target layer are calculated to obtain the weight of the entire indicator system.

##### 5.1.2 Establishment of the scoring mechanism

According to the calculated weights of each influencing factor and the corresponding scoring criteria, each influencing factor of the Shared Integration Degree is scored and weighted summed to finally obtain an evaluation score. The basic formula of the Shared Integration Degree evaluation system is:

$$D = \sum_{i=1}^n W_i X_i$$

Among them, D represents the evaluation index of the Shared Integration Degree,  $X_i$  represents the value of the i-th factor, where the factor is the value of the indicator,  $W_i$  represents the weight of the i-th factor, and  $n$  represents the number of evaluation factors.

### 5.1.3 Spatial Grade Division

The land use is divided according to the magnitude of the Shared Integration Degree value, and the characteristics of various terrains suitable for sharing are comprehensively analyzed to scientifically match the time.

Since all kinds of spaces within the residential area have certain functions, spaces with relatively weak functionality are easy to tap the potential of parking Spaces or achieve external sharing. In addition, considering the dual impact of location on accessibility and privacy, the higher the accessibility of a space, the lower its privacy is generally and the easier it is to contact the outside world. Therefore, the three types of Shared Integration Degree spaces have the characteristics of weak functionality and high accessibility. For spaces with average accessibility and certain functionality, their openness and shape rate will rise to become the main factors affecting the Shared Integration Degree, spaces with a certain normative area or relatively regular ones are more likely to achieve sharing compared to fragmented spaces. Therefore, the spatial characteristics of the second type of Shared Integration Degree are regularity and scale, the spatial characteristic of the first type of Shared Integration Degree is fragmentation. For spaces with strong functionality, poor accessibility and high privacy, it is not easy to tap the potential of parking spaces and share them, and they are considered to lack the feature of sharing.

### 5.1.4 Methods for tapping the potential of parking spaces at all levels

#### (1) Methods for tapping the potential of the first type of Shared Integration Degree space

##### ① Functional merger and spatial mosaic[19]

In the first type of Shared Integration Degree space, both fragmented green spaces and main ancillary road spaces have certain functionality, and the shape rates of these two types of spaces are not high, which is specifically manifested in the small area of fragmented spaces and long and narrow shape of ancillary road spaces. When sharing and tapping the potential of parking spaces for these two types of spaces, the primary consideration should be to maintain the existing functions of the space to the greatest extent, the original green space ratio is maintained indirectly through grass bricks, and the walking space should be guided toward the inner side to ensure the continuity of the walkway. The parking space, as an external patch, is embedded in the original space, which not only eliminates the need for large-scale demolition and construction, but also increases the shared parking spaces in the residential area.

##### ② Core reservation and edge sharing

For spaces with high frequency of crowd activities such as group green spaces and irregularly central green spaces, the areas where activities occur intensively are designated as core activity spaces and reserved for activities. Generally, the potential of parking spaces will not be tapped. The space outside the core activities can be comprehensively considered based on road traffic conditions, the four densities of space, functionality and the frequency of crowd activities, then parking spaces in the marginal areas can be tapped and shared.

For the group green space, the scale of the space is limited, and it is not easy to form a centralized parking space. The space can be dispersed in the edge area. In addition, the group green space and the irregularly central green space are generally adjacent to the main ancillary roads within the residential area. The original conditions of the main ancillary roads are relatively good, and the road width is generally greater than 9 meters, so part of the main ancillary roads can be occupied. Then the walking space can be extended to the green activity space to complete the excavation of the parking space. As the highest level of green space within residential areas, the irregularly central green spaces have a certain scale. In residential areas with a shortage of parking spaces, small parking spaces can be considered to be set up at the edge of the central green space to centrally solve the parking problem within the residential area. In addition, in residential areas where funds are available and there is certain technical support, and it is possible to consider rebuilding the central green space and building an underground parking lot under the central green space. As depicted in Figure 5-1.

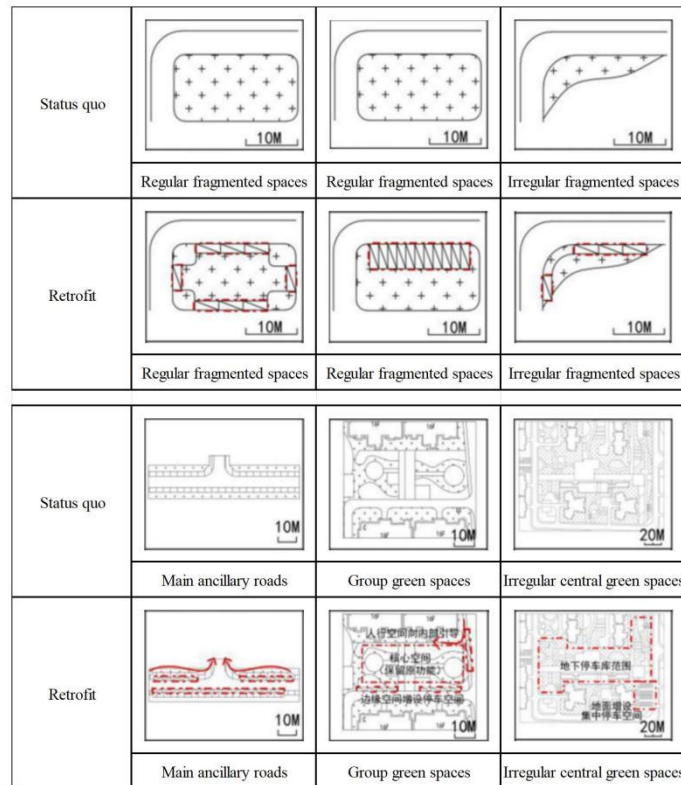


Fig. 5-1. The renovation strategy plan of the first type of Shared Integration Degree space

(2) Methods for tapping the potential of the second type of Shared Integration Degree space

① Turn waste into treasure and reuse

In the second type of Shared Integration Degree space, the open spaces between internal residential buildings and the inefficient spaces on the ground floor of residential buildings are in an idle state. Therefore, the spaces can be renovated, endowed with new functions, and reused.

The inefficient space on the ground floor of residential building refers to the ground floor space that exists in the residential buildings of old residential areas and has a relatively low usage efficiency and is basically in an abandoned state. This kind of space can be used as parking space by breaking the barrier of the ground floor space on the basis of retaining the original structure of the residence. For the open spaces between internal residential buildings, when the width of the space is over 2.4 meters and the length is over 10 meters, parent-child parking spaces can be designed for residents to use. This can alleviate the problem of parking difficulties within residential areas.

② Three-dimensional parking and functional superposition

Regularly central green spaces are generally located at the center of residential areas, and three-dimensional mechanical parking spaces can be appropriately arranged in such spaces. For such spaces, part of the green space can be appropriately occupied, and grass bricks can be used to realize the combination of parking spaces and ecological spaces, so as to realize the functional superposition of space[20].

As a space with a high frequency of crowd activities within the residential area, the central square has obvious functionality. Therefore, it is not appropriate to open up parking spaces on the ground. Instead, underground parking spaces building should be considered in light of the actual situation[21], and the spatial relationship between crowd activities and the entrances and exits of the underground parking lot should be appropriately handled. As depicted in Figure 5-2.

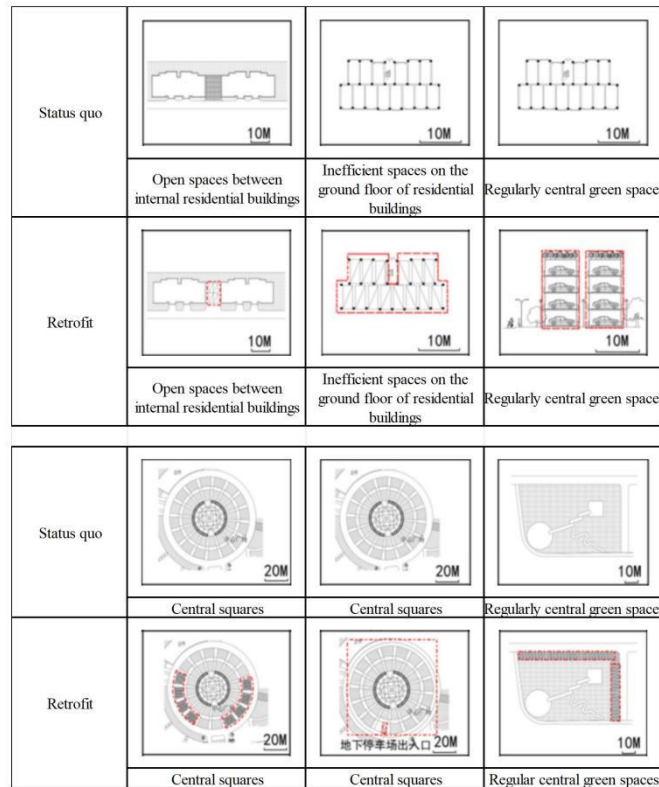


Fig. 5-2. The renovation strategy plan of the second type of Shared Integration Degree space

### (3) Methods for tapping the potential of the third type of Shared Integration Degree space

#### ① Utilize space skillfully and design meticulously

In the second type of Shared Integration Degree space, idle land and existing parking spaces do not have other special functions, and the shape rate is generally low. For the renovation of parking spaces in this type of space, the focus should be on how to make full use of the space and conduct refined design of the parking spaces to achieve the effect of maximizing the number of parking spaces.

The potential tapping of the existing parking space mainly lies in the issue of parking space division. Most of the existing parking spaces are mainly parallel parking. Although the required depth is relatively small, the unit parking area is large and the space utilization efficiency is extremely low. According to the specific situation, the refined design of parking spaces[22] can greatly improve the space utilization rate. If the depth allows, parking spaces can be divided at an angle. The higher the degree of inclination, the smaller the unit parking area required and the higher the space utilization rate. Generally, an inclination angle of 45 or 60 degrees is adopted. In the case of ideal depth, vertical parking with the smallest parking area can also be used.

For idle plots in the community that have not been built due to certain reasons, they can be transformed into parking lots for use, and grass bricks can be added if necessary to increase the green coverage rate of the community. Or three-dimensional mechanical parking devices can be used to more effectively tap the potential of space. Since the distance between idle land and residential buildings is relatively large, the number of floors of three-dimensional mechanical parking garages can be appropriately increased, generally ranging from 2 to 4 floors.

#### ② Sharing adaption and convenience creation

The green spaces at the edge and the open spaces between residential buildings near the entrance have good accessibility. By taking advantage of the convenience, parking spaces can be set up on one side of the road, just make sure to leave a pedestrian passage. The shared parking spaces can also be monitored in real time in combination with the monitoring system in the residential area to create a flexible and convenient system for external sharing. As depicted in Figure 5-3.

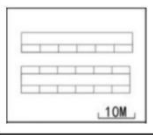
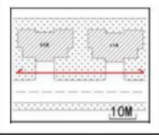
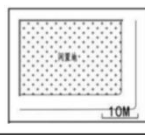
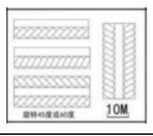
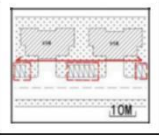
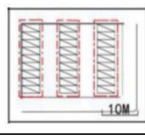
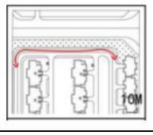
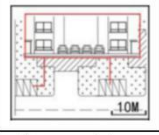
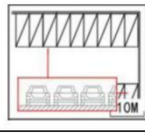
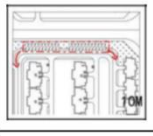
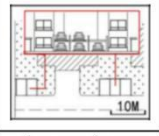
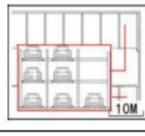
Status quo			
	Existing parking spaces	Open spaces between residential buildings near the entrance	Idle plots
Retrofit			
	Existing parking spaces	Open spaces between residential buildings near the entrance	Idle plots
Status quo			
	The green spaces at the edge	Open spaces between residential buildings near the entrance	Idle plots
Retrofit			
	The green spaces at the edge	Open spaces between residential buildings near the entrance	Idle plots

Fig. 5-3. The renovation strategy plan of the third type of Shared Integration Degree space

## 5.2 Tidal parking

The "tidal parking" solution is the core of the smart shared parking system[23], which utilizes a large number of vacant parking spaces in residential areas during the day to alleviate the parking difficulty problem within a certain range of the surrounding area. Based on the premise of the Internet and the encouraging social innovation mechanisms, and new functions such as parking space reservation, intelligent docking[24], and comprehensive services are set up accordingly, which also promotes the establishment and improvement of the smart shared parking system.

### 5.2.1 Construction of the Community Smart Shared Parking Platform

The evaluation system for the Shared Integration Degree has been constructed, which scores various spaces within the community and classifies them into three levels of spaces, and studies the potential tapping methods of parking spaces at each level respectively. After completing the potential tapping of parking spaces at the spatial level, the number of parking spaces in the existing community has increased. Meanwhile, in order to implement the concept of shared parking, we have designed the "Quick Parking" platform, which combines the design concepts of "efficiency", "sharing", "convenience" and "personalization" to create a shared parking system suitable for the public.

## 5.3 Spacetime Shared Parking System from the Perspective of Smart Cities

According to the demand for "tidal parking", the Internet and innovative technologies are utilized to share the existing and newly added parking spaces in the existing community, building a smart shared parking system for the existing community to alleviate the parking pressure in the area and promote the construction of smart cities.

## 6. Conclusion

In today's rapid development and construction of science and technology, on the one hand, people's income level has increased, the number of cars has risen sharply, and the gap of parking spaces has increased gradually; on the other hand, the usage rate of parking spaces in some large and medium-sized cities is low, and the private parking spaces in the residential areas are in the state of idleness during the working hours, while the parking spaces in the large shopping malls are in the state of idleness in the night time. Therefore, as governments around the world strongly advocate smart cities and parking space sharing to alleviate parking difficulties, shared parking is considered to be an effective means to alleviate the tightness of urban parking resources and manage parking chaos. This project is rooted in the theory to establish the construction model of the technical method for the implementation of shared parking on the ground, exploring the method for the implementation of shared parking on the ground, constructing a space-time community shared parking system in the field of the smart city, integrating the idle parking space resources through the matching system, and providing them to the demanders of the parking spaces, solving the asymmetry of the information of the supply and demand, improving the utilisation rate of the parking spaces, solving the utilisation of the idle resources in the society, and increasing the efficiency of the social operation. It is of great significance, and also has certain reference and reference significance for the development of future established community parking space sharing management strategy page.

In the process of constructing the sharing matching system, this study also innovatively proposes the degree of sharing combination to make up for the research gap of privacy and security protection in the process of shared parking implementation, thus systematically exploring the technical methods of shared parking implementation, deepening the theoretical perspective of the field of shared parking implementation, and constructing the theoretical model of shared parking implementation technology. In view of the research progress of the current project, we can further expand in the following aspects in the future:

1. Dynamically mastering the real-time data[25] of the parking spaces in the registered settlements of the matching system. The implementation of car parking space monitoring can further improve the effectiveness of the matching system and the sensitivity of real-time data according to the research design procedures related to the platform booking control strategy. At the same time, customers can be incentivised to provide demand information in advance through dynamic pricing;

2. Expanding existing parking resources, tapping possible parking spaces in settlements, and increasing the additional functions of the space amount to improve the utilisation rate of existing resources;

3. Enhance the quality of human settlements. Through the promotion of community shared parking systems, the problem of loss of public space within settlements due to parking constraints can be mitigated and the number of on-street parking in and around settlements can be effectively reduced while utilising unused resources.

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