The Research on the Integration of Individual Parking Garages into Underground System

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Abstract. The current situation of parking system caused by the increase of domestic car ownership rate is analyzed. The advantages and disadvantages of the present mechanical parking garage are introduced. A single import and export in the parking garage will cause congestion and the user will wait for too long. Aiming at the shortage of the existing mechanical parking garage, a new combinable underground parking system is designed which utilizes multiple combinations of parking garages and sets up multiple lifting parking trays. Through analysis, this new underground parking system will greatly improve the space utilization rate and reduce the parking time.

1. Introduction
The existing urban parking facilities include roads, parking lots, residential areas own parking spaces, etc. can not afford the rapid growth of the number of cars nationally. Such a large gap in parking space leads to parking difficulties and random parking directly. Taking the large population density and shortage of construction land into consideration, we recommend vigorously to develop high-tech mechanical parking garage without increasing ground building density and reducing ground greening area. It is safe and reliable, which makes the most use of underground resources and also saves land space. It improves the efficiency of the use of unit land area by making full use of the "corner surplus" to build parking lots. In the future, the design of mechanical parking garage will be harmonious with the urban environment, which will make it become a mechanical urban building practical, ornamental and economical.

2. The Purposes Of Design
Presently, mechanical parking garage has not been widely used. It only gets preliminary development in Beijing, Shanghai, Guangzhou, Nanjing, Shenzhen and other cities. Just in its infancy but the advantages of it in solving parking difficulties in urban central areas are becoming more and more evident. It plays an important role in changing people's parking concept, promoting the healthy development of urban static and dynamic traffic, and even promoting the development of automobile industry. Based on the existing mechanical parking system, we design the three-dimensional parking system using the combination of several three-dimensional parking garages. Effective use of space structure to erect multiple lifting parking pans makes the integration of multiple imports and multiple exports in the parking system come true. In this way, the work efficiency has been greatly increased.
The new mechanical parking mode can give full play to its maximum functionality and economy. It provides a good way for the city to solve the parking problem and also puts forward new design concepts for designers in the design of parking facilities.

3. The Principles Of Working
As showed in picture1, the design includes a cylindrical parking device and a controller connecting the parking device. The parking device comprises a support frame and a multi-layer rotary parking disk arranged in the support frame. The rotating parking device is covered with a plurality of sector parking spaces by circle around the center which is matched with guide. In this model, eight small and medium-sized vehicles can be parked. The parking device is provided with a vehicle entry and exit device which makes parking and pick-up possible. The support frame owns a multi-layer support cross plate that used for supporting the rotary parking disk. The support frame surrounded by a large number of supporting vertical plates connected to the ground. Compared with the prior design, the invention adopts a multi-layer circular rotating mechanical structure. Some small and medium-sized cars can be parked on each floor. Every parking space on each floor is equipped with guideways. Occupied smally, parked much, the vehicles can be parked and taken out by means of the vehicle entry and exit device in the middle.

Picture 1: Structural design model of parking device
1-Rotary Parking Disk; 2-Lifting Platform; 3-Lifting Device; 4-Car Loading Trailer; 5-Track; 6-supporting transverse plate; 7-supporting vertical plate connecting ground; 8-separator; 9-synchronous wheel;

In addition, the original design of the parking system depends on a plurality of the above parking devices and the vehicle entry and exit devices between them. Using the distribution and arrangement of several cylindrical parking devices, vehicle entry and exit devices are skillfully arranged. The problem of congestion of multiple vehicles leaving simultaneously will be solved. The layout of the parking system in the "multi-in, multi-out" mode can be seen in picture2. Arranged in three dimensions, four cylinders make four entrances and five exits possible. Clearly, blue dots denote vehicle entry and exit devices, white wheeled structures denote rotating parking disks, and arrows...
denote the moving direction of vehicle entry and exit devices. The vehicle entrance is arranged on the
top of the vehicle entry and exit device. Vehicle exits are set at the top of the other five vehicle entry
and exit devices. The efficiency of exit has accelerated by selecting the exit near the vehicle.

The signal input unit equipped by control system of the parking system is used for inputting the
number and loading position of the loaded vehicle and processing the data of loading or unloading
orders. According to loading or unloading instructions, the controller orders the driving unit of lifting
platform and lifting device, and carries out parking fee. Moreover, combined with APP, intelligent
parking, picking-up, parking fees and self-payment are installed. It is very convenient for car owners
to reserve parking garages remotely and pick up cars, and to find out whether there is an empty
parking space in the parking lot independently.

4. The Advantages Of Design
Compared with the prior design, the invention shows advantages in following parts:

1) Some small and medium-sized cars can be parked on each floor. Every parking space on each
floor is equipped with guideways. Occupied smally, parked much, the vehicles can be parked and
taken out by means of the vehicle entry and exit device in the middle.

2) The parking device is cylindrical. The distribution and arrangement of several cylindrical
parking devices are used. The problem of congestion of multiple vehicles leaving simultaneously will
be solved.

3) The rotating parking disk inside the parking device leads "multi-in, multi-out" more quickly
and effectively. The problem of congestion of multiple vehicles leaving simultaneously solved by
choosing the nearest exit through lifting device. It has the advantages of convenient access to vehicles,
fast access speed and great flexibility.

4) Connected to Internet + and mobile application, intelligent booking parking and car taking
realized. Time and energy are saved by calculating parking fee through mobile APP and setting up
self-service payment functions.

5. The Prospects Of Application
1) Promoting new architectural design concepts.

2) Applied to construct new residential quarters.

3) Establishing parking information management platform and realizing parking information
sharing.
In the future, Internet information technology will be adopted. When the regional unified parking information management platform established and data form the dynamic traffic information network can be shared, we could achieve the joint control of parking information network and guide the information to be released in all directions. Through Wechat Public Number and Mobile App, the public know the parking location and parking situation at any time. Parking reservation, staggered peak parking and activate parking can gradually realized that produce scientific overall planning and fine management of parking resources.

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