Adaptive reuse of parking in the cities of the future

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Abstract. The article considers the problems of modern highly urbanized cities caused by the irrational development of transport infrastructure, emphasizes the need for sustainable transport systems. The problem of reducing the life cycle of automotive infrastructure (parking garages) is considered. The international experience of reconstruction and adaptation of parking lots is analyzed. Typological features of the design of parking lots with the possibility of their subsequent adaptation are revealed.

1. Introduction

In modern cities, as in places of concentration of economic and social resources, the majority of scientific innovations are introduced and engineering breakthroughs occur. Cities have become the source of a huge number of technological advances. All these processes lead to even greater urbanization and more intensive innovation. On the other hand, cities not only provide access to great opportunities, benefits and resources, but also cause a large number of different problems.

In the second half of the 20th century, many cities were adapted and designed taking into account the active use of personal vehicles. A car was considered as a symbol of modernity, mobility and development. Highways were built, streets were expanded, and storage facilities for motor vehicles were organized. It is the transport infrastructure and types of movement that largely shape the look of modern cities. With the active growth of motorization in cities, new problems have arisen. The problems are associated with a decrease in the efficiency of transport infrastructure - its slower development in relation to the level of motorization. In addition, the increase in the level of motorization increases the demand for parking spaces, which creates problems with rational land use, especially in central and residential areas of cities. Since the 1980s, active motorization has begun to be perceived negatively, and in some cities measures are being taken to restrict automobile traffic [1].

The modern experience of successful cities in terms of transport planning shows that a comprehensive solution to urban transport problems is impossible only by building up the automotive infrastructure. The Global Report on Human Settlements 2013 «Planning and Design for Sustainable Urban Mobility» report on the need to change modes of transportation: by increasing the share of public transport and non-motorized ways of promoting (cycling, walking) and reducing the number of travel to personal transport [2].

In recent years, there has been an active development of automated technologies. Various studies predict that by 2040 in most major cities in the world will appear completely autonomous transport systems, that is, not requiring human intervention, including as a driver. In this regard, there are studies that predict a future reduction in the need for car storage. In the era of turbulent economic, political, social, environmental, and technical changes, the life cycle of urban infrastructure is getting shorter, because only current problems and solutions are taken into account when creating [3,4].

In the light of all these elements, there is a need to design parking lots that meet current needs and can adapt to other functions in the future.

2. Methods

Analysis of scientific literature. The modern theoretical concepts of sustainable development of cities and transport systems are considered. The international experience of reconstruction and adaptation of parking lots is analyzed. The specific features of the design of parking lots with the possibility of their subsequent adaptation are revealed. Fundamental to this study is an integrated approach to solving transport problems to form a comfortable highly urbanized environment of modern cities.

3. Results

In developed countries, the negative impact of vehicles began to manifest itself in the middle of the last century. Automotive infrastructure was actively modernized in these countries: the road expanded, the standard for providing parking spaces increased, but all these measures led to even greater growth in motorization. In the 1990s Bern residents demanded to reduce the number of parking lots in the city center. A referendum was held. There was decided to no longer build multi-level parking garage and limit the number of parking lots in new residential districts. Representatives of business communities and the Chamber of Commerce objected. In 1997, a compromise was reached: the total number of parking lots was decided to remain unchanged, but their number in the aboveground floors needed to be gradually reduced. This implied, among other things, the gradual transformation of existing multi-level parking garages. In 2010, the Lowen Garage multi-level parking was turned into an apartment building in the central district of Bern (Breitenrainstrasse). According to the «Burckhardt + Partner» project, a new building was added to the parking building from the north. It repeated the number of storeys and materials of the facade of the reconstructed structure. On the first and second floors, the workshop and commercial premises of the garage turned into townhouses. Access to them is through the front patio. The reconstruction was carried out thanks to the flexible design of the parking lot. The height of the first floor of more than 3 m made it possible to place residential premises and objects of trade, services and leisure there. In the future, the purpose of the premises can easily change from residential to non-residential and vice versa (figure 1).

The adaptation of the Peckham Levels multi-level garage, built in the 1980s in a vibrant district of southeast London, caused a number of difficulties due to low ceilings and sloping floors. A cinema is located on the first level of the parking, the middle floors occupy public spaces and workplaces, and seasonal rentals for bars and patios are provided on the top floor [5,6].

The reconstruction of the parking lot did not involve major changes, since the reconstruction budget was limited and amounted to about $ 42 per square foot. Design decisions touched outdoor walls and installation of the necessary engineering systems. There is a marking on the parking spaces on the floor, chipboard panels divide the working areas, the corridor is illuminated through transparent polycarbonate panels. The main difficulty in adapting the parking was the low height of ceiling. The height to the bottom of the beams is 7.5 feet (2.286 m). The solutions to this problem were achieved by placing partitions dividing the working rooms under the beams, and air ducts were laid along them. Another difficulty consisted in floors (figure 2). It made with a slope for runoff. In larger coworking spaces, plywood floors on leveling battens allow people to sit around a long table. Another challenge for the designers of this project was the low potential of the supporting structures. In this connection, under the premises with the highest payload: bars, music venues and a dance floor, the supporting beams were reinforced carbon-fiber reinforcement. “If we were asked to design a carpark now,” says O’Brien, “we would ask the clients or the engineers whether we could potentially future-proof it in terms of loading and ceiling height” [7].

In connection with global trends to reduce the number of vehicles there are buildings with parking lots designed for subsequent adaptation. The owners of such buildings believe that the additional construction costs will pay off in the future. The Lincoln Station residential complex, built in 2017 by the Camden Property Trust, demonstrates certain views on the current market and future trends. The parking building is constructed in such a way that in the future it can be converted into apartments. The clean ceiling height of the parking lot is 10 feet (3.05 m) on the ground floor and 9.6 feet (2.92 m)

on three floors higher, and the distance between the columns is 27 feet (8.22 m). The cost of building a parking was about 5% higher than usual. In the future, when tenants of a residential building will need less parking lots, the parking will be transformed into a residential building.

Figure 1. «Löwen Garage», Berne, Switzerland.

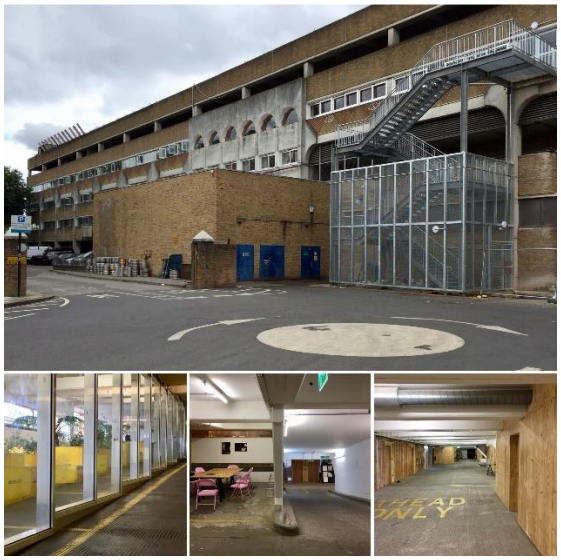

Figure 2. «Peckham Levels», London, United Kingdom.

The structure of the 9th Avenue Parkade Innovation Center, designed by the architectural bureau 5468796, has a built-in parking for 510 parking lots (figure 3). This parking will have to serve the new East Village library and local businesses. On the first and second floors there is an innovation center, which is a multifunctional space for local manufacturers and entrepreneurs. On the top five levels is a parking lot designed with the possibility of conversion in the future into residential and commercial premises.

Vertical movement in the parking is carried out on a semicircular ramp. The ramp is designed in such a way that the first level is easily dismantled, and the upper levels with a slope of only 2% will be converted into segmented terraces. The load-bearing structures are designed taking into account further use for residential or commercial functions. Ceiling heights are between 12.5 and 14 feet (3.81 - 4.27 m). According to preliminary estimates, the construction of such a building exceeds its cost by 10%.

Figure 3. «9th Avenue Parkade», Calgary, Canada.

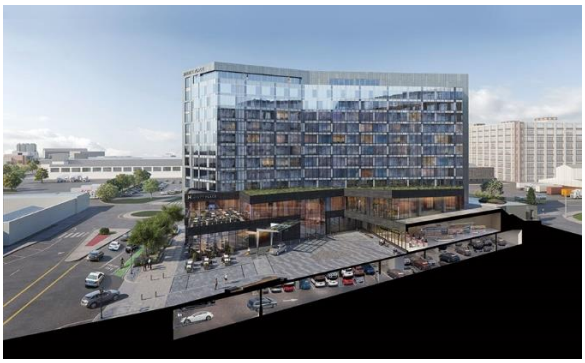

Figure 4. «Parcel K», Boston, USA.

The adaptation of underground parking is the most difficult. In the project of the multipurpose building Parcel K designed in 2015 by Arrowstreet, the architect refused a three-level underground

parking. Reducing the number of parking floors to one, reduced construction costs by about $ 18 million. The project provides a one-story underground parking, accommodating from 197 to 420 parking lots (figure 4). Variation is achieved through compact, achieved with two-post parking lift. The use of such devices can increase the parking capacity by placing one car on top of another. The height of the parking floor has been increased to 4.7 m. The project provides for a scenario according to which in the future part of the parking can be combined with the aboveground part of the building to form a two-level space, and convert it to other functions [8-10].

4. Discussion

The service life of many parking is about 50-75 years. Considering the development of the transport structure, modernization and improvement of types of transportation, the need for parking can be significantly reduced in the future. It is not rational for a developer to build buildings with relatively quick obsolescence. Some argue that it is easier and cheaper to demolish an existing building and build a new one that meets current requirements. Moreover, an analysis of world experience shows that the design of parking, taking into account their further adaptation, is the most far-sighted and effective solution an economic and environmental point of view. When designing adaptive parking, it is necessary to consider a number of space planning, design and engineering features. Among them are the following: floor height, the possibility of future adaptation of vertical communications in the parking lot, ensuring evacuation and fire suppression systems, calculation of payload of load-bearing structures considering the adaptation, type of structural system, the possibility of subsequent installation of engineering systems and communications, can be easily removed or adaptable facades of the parking. The use of such design solutions increases the cost of construction by an average of 5-10%, but at the same time, operating costs and expenses necessary for the subsequent modernization of parking are reduced [11-13].

5. Conclusions

Summing up, it should be noted that despite the current level of motorization, not all paid parking lots are 100% full. In the future, with the increase in the share of public transport, with the development of self-driving vehicles, the wider spread of car sharing, the need for parking lots can be significantly reduced. As international experience shows, the adaptation of some old ground parking is possible, but complicated by a number of factors and requires certain financial costs. The potential reuse of existing underground parking lots is much lower. In modern practice, when designing parking, it is necessary to take into account the unique needs of a particular place, not only current, but also future. And try to fully satisfy them.

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