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INTELLIGENT BUILDING, AUTOMATED CAR PARKING SYSTEM

Summary. The incentive to raise the subject of automated car park is still too small number of parking spaces in the cities, as well as continuing problems arising from traditional car parks (the problem with parking, cars damages, or even collisions) and, consequently, increasing frustration and nervousness of drivers, often leading to contentious situations. The idea to address this situation, and even the solution of the problem, would be to design automated car parks, and thus create a design harmonized with the environment in which this project would be realized. With the progress in technology, the development of electronics and ubiquitous automation the automated car park, which is a hybrid of construction, architecture, and advanced electronics was created.

Keywords: parking, parking systems.

INTELIĞENTNY BUDYNEK, SYSTEM AUTOMATYCZNEGO PARKOWANIA SAMOCHODÓW

Streszczenie. Bodźcem do podjęcia tematu automatycznego parkingu jest wciąż zbyt mała liczba miejsc parkingowych w miastach, a także ciągle problemy powstające na tradycyjnych parkingach (problem z zaparkowaniem, uszkodzenia samochodów, czy nawet kolizje), a w konsekwencji rosnąca frustracja oraz zdenerwowanie kierowców niejednokrotnie prowadzące do sytuacji spornych. Pomysłem na rozwiązanie takiej sytuacji, a nawet samym jej rozwiązaniem byłoby zaprojektowanie automatycznych parkingów, a co za tym idzie – stworzenie projektu zharmonizowanego z otoczeniem, w którym ów projekt miałby powstać. Wraz z postępem techniki, rozwojem elektroniki i wszechobecną automatyzacją powstał parking automatyczny, będący hybrydą budownictwa, architektury i zaawansowanej elektroniki.

Słowa kluczowe: parkowanie, systemy parkowania.

1. The idea of parking systems

Intelligent housing - this type of housing is inevitably associated with a building management system, and fields such as automatics, automation and high-tech architecture. Automatics is a field of science and technology dealing with issues of process control, in particular, technological and industrial, which in turn comprises another field - automation, aiming at reduction or complete replacement of human mental and physical work with machines and robots work. Machines and robots do not only replace human work, but also often do the work, which for various reasons the man is unable to do. Automated parking system (APS) was developed in order to reduce the area designated for parking cars. Similarly, as in the case of multi-level car parks, so in the case of APS, the approach taken is to park vehicles in multi-level vertical stacks in such a way as to limit the use of the land designated for car park while ensuring the maximum number of parking spaces [1]. In the literature, APS is encountered under many names, some of which are:

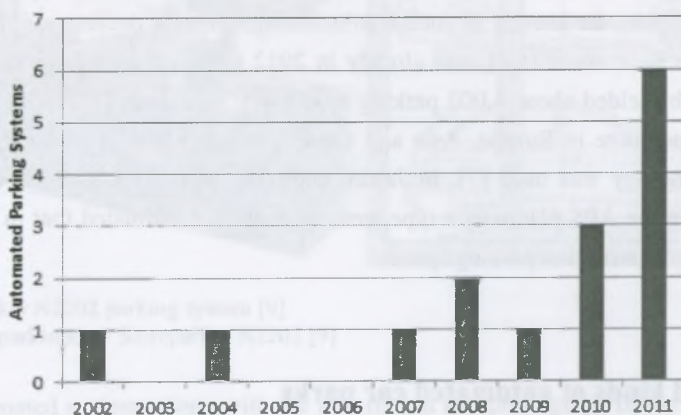
- automatic parking system (APS) (not to be confused with the system used in motor vehicles),
- automated parking facility (APF),
- automated vehicle storage and retrieval system (AVSRS),
- car parking system,
- mechanical parking,
- robotic parking garage. [1]

Such solutions are used in European countries and in the world in high-density urban housing, where the amount of available space allocated for car parks is very small. In Poland the interest in such solutions is growing, which is revealed in the article posted on the pages of motofakty.pl web site, which says that in the car parks made in the traditional aboveground or underground technology, only 32% of the area are parking spaces, for example experts from Kraków company specializing in the design and realization of parking investments after conducting expert survey concluded that parking spaces are just a third of the total area of the car park made in the traditional technology of aboveground or underground buildings. They insist that increasing the number of parking spaces in the same investment area from several times to a dozen times becomes possible through the use of increasingly popular parking platforms systems. The most technologically advanced variety of platform systems - automated car parks - is an increasingly used solution to ensure public parking spaces in big agglomerations. Creation of the first facilities of this type dates back to the beginning of the twentieth century, in the United States and France, but only now they are making an authentic comeback when devastating deficit of parking spaces is felt and when awareness of environmental threats increased [2].

The following table shows the interest in automated car parks in the years 2002- 2012 in North America (Table 1).

Table 1

Chart showing the increase in the number of car parks in consecutive years [3]



A concrete example of such an investment in Poland may be the "Smart Parking", which is located in Wyzwolenia St. in Mikołów. It is the first such structure in the country. The structure has the height of over 13 meters; it resembles a big wheel, and technologically a paternoster. By using such a solution up to sixteen cars can be parked on the area needed for two cars (Fig. 1).



Fig. 1. The photograph of the car park in Mikołów [4]

Rys. 1. Fotografia parkingu w Mikołowie [4]

2. The history of automated car parks

With the increase in the number of vehicles in high-density urban housing the problem with a limited amount of parking space appeared. The solution to this problem is the automatic parking system (APS). The first such system was created in Paris in 1905 - garage Rue de Ponthieu [5].

In the United States APS attracted attention in the years 1940-1950, and the systems used were Bowser, Pigeon Hole and Roto Park [5]. In the years 1957 to 1974 Bowser and Pigeon Hole systems were used [5], but due to frequent mechanical problems and prolonged waiting time for the vehicle, the interest in such a solution significantly decreased [6]. This interest, however, came back since 1990, and already in 2012 there were 25 projects planned or in progress, which yielded about 6,000 parking spaces [7]. While until 1990 the interest in the systems was mediocre in Europe, Asia and Central America, since 1970 in the APS more advanced technology was used [7]. In Japan, since the early 1990's about 40,000 parking spaces based on the APS paternoster type were created. It is estimated that in Japan in 2012 there were about 1,6 million parking spaces.

3. Types and kinds of automated car parks

With the growing interest in the APS, and consequently, the demand for this type of technology, the quantity of companies engaged in this type of technology also increased. Along with this fact, followed the naming diversity among solutions applied by the given company, as semiautomatic and automatic car parks began to appear. Semi-automatic car parks are lifts placed on the ground floors of car parks, which can accommodate one or more vehicles. In turn, automated car parks are automated parking structures with an installed lift for cars and computer service system.

To illustrate the fact systems of three companies involved in the construction of such car parks will be presented.

Nowina Konopka Platformowe Systemy Parkingowe is the general representative in Poland of OTTO Nussbaum GmbH & Co. KG KG AUTOPARKSYSTEME – the leading European platform systems market, having its own laboratory and production facilities in Germany. Its solutions together with the description will be presented first.

Platforms – a platform system along with the description and photograph of the chosen model: Storeparker N2202, it is the simplest model of dependent parking system with horizontal parking platforms. The car enters a lowered platform and is lifted up, so that the lower vehicle can park underneath it. The top car can leave only when lower position is vacant. These devices can be compiled in a row in any number of modules (Fig. 2).

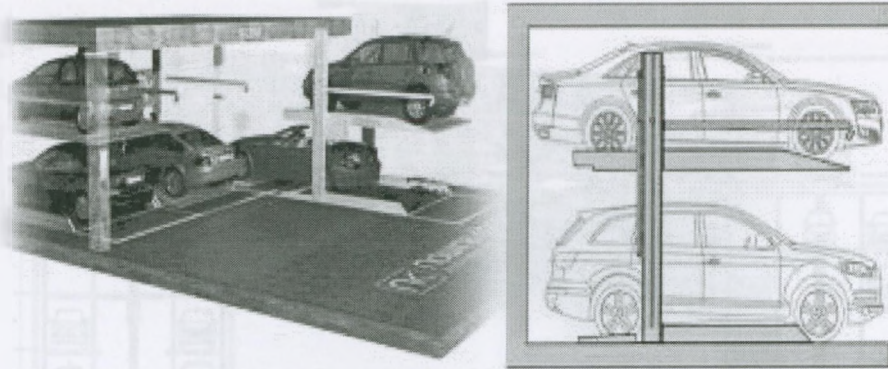


Fig. 2. Storeparker N2202 parking system [9]

Rys. 2. System parkingowy Storeparker N2202 [9]

Semi-automated systems along with the description and photograph of the chosen model: Parkline N5102, it is an integrated semi-automatic system without a pit that allows independent parking. The system operation is based on a combination of platforms sliding horizontally and raised platforms. The bottom row of the device are horizontally movable platforms in the amount of segments -1 (Fig. 3).



Fig. 3. Parkline N5102 parking system [9]

Rys. 3. System parkingowy Parkline N5102 [9]

Automatic systems along with the description and photograph of the chosen model: Borderparker, it is one of the most automated parking systems. This arrangement of pallets arranged longitudinally one behind the other, coupled with a lift serving them, usually situated in a central location. The system can be compiled of one, two or three pallets on one or both sides of the lift shaft on many levels. It can be placed under the ground (Fig. 4).

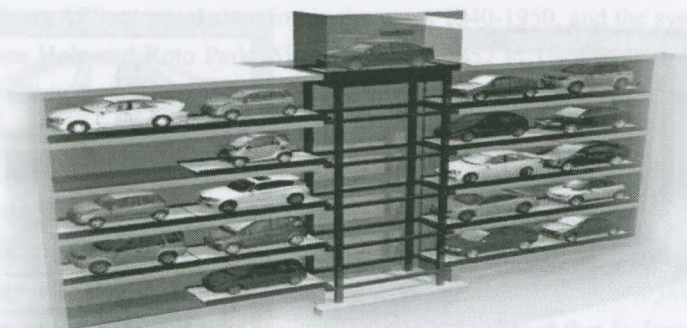


Fig. 4. Borderparker parking system [9]

Rys. 4. System parkingowy Borderparker [9]

The laterally movable platform system N6301 is used for independent parking of motor vehicles in rows (one after another) inside buildings. A row of platforms precedes a row of traditional parking spaces, thus enabling double (or triple in the case of two rows of platforms) increase the number of parking spaces served by a single access road (Figure 5).

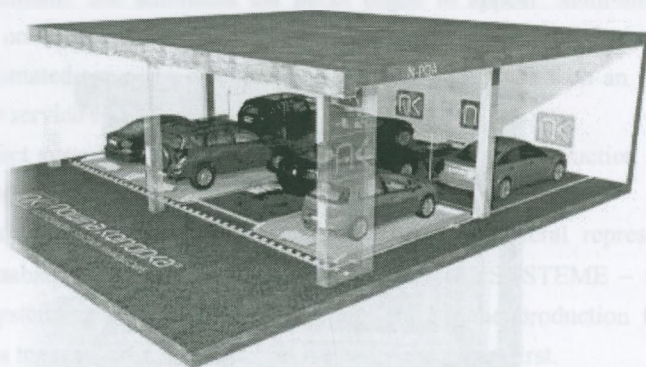


Fig. 5. N6301 parking system [9]

Rys. 5. System parkingowy N6301[9]

The Stolzer company uses a different division of systems:

LP-type parking system – is a system which can be used in already existing buildings as well as in newly built structures; it can even be used in places with limited space. Its height can be up to eight stories, while, in order to provide parking spaces to vehicles of various sizes, floors can vary in height and length to 100 meters. Depending on the configuration, this system offers two solutions: auto LPM with the exchange room located above the parking spaces and the exchange unit located between the shelves (Fig. 6), or the auto LPS with the exchange room located over the shelves (Fig. 7).

The auto-LPM configuration
(Transfer room centered above the SRU lane between the racks, required with
abstract turntable)

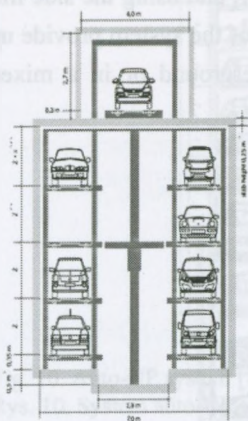


Fig. 6. LPM system [10]
Rys. 6. System LPM [10]

The auto-LPS configuration
(Transfer room centered above the rack structure, required with using a turntable)

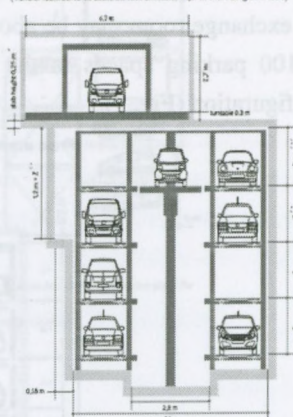


Fig. 7. LPS system [10]
Rys. 7. System LPS [10]

– Auto-SP type parking system – is a universal high capacity parking system. It can be built in the following configurations: placed aboveground, underground or in a mixed configuration. It is designed to provide a large number of parking spaces. Thanks to the modular design it can be located in buildings with different requirements (Fig. 8).

Parking places in a concrete structure, under ground

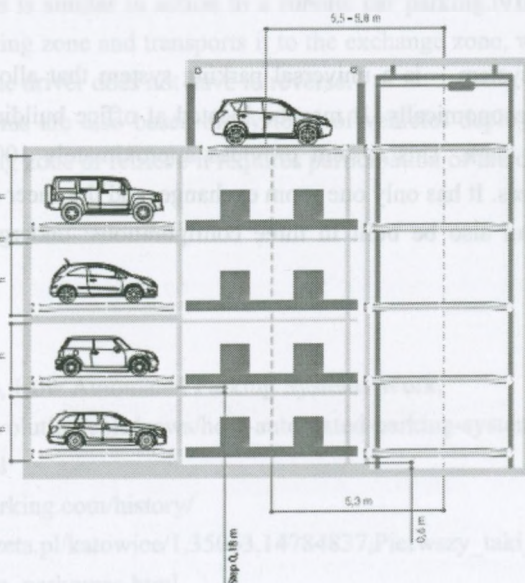


Fig. 8. Auto-SP system [10]
Rys. 8. System auto-SP [10]

Auto-TP parking system – thanks to its modular design, this parking can be expanded up to 50 meters in height. Exchange rooms may be located on each floor, and using the side lift, the exchange room may be above the car park. The smallest models of the system provide up to 100 parking spaces in the structure located aboveground, underground or in a mixed configuration (Fig. 9).

Free standing steel structure, above ground

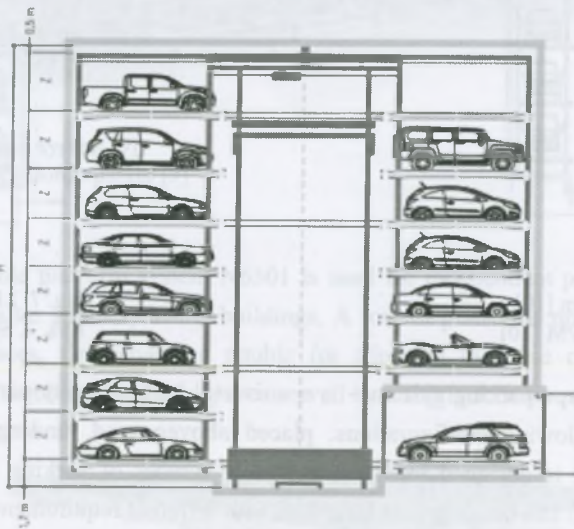


Fig. 9. Auto-TP system [10]

Rys. 9. System auto-TP [10]

Auto-UP parking system – is a universal parking system that allows building of more parking spaces, more economically. It may be located at office buildings, hotels, dorms or built as a public car park. This system provides approximately 100 parking spaces for vehicles of different sizes. It has only one room exchange, and the sheer structure is 20 meters high. This car park can also be built in three configurations: underground, aboveground, mixed (Fig. 10).

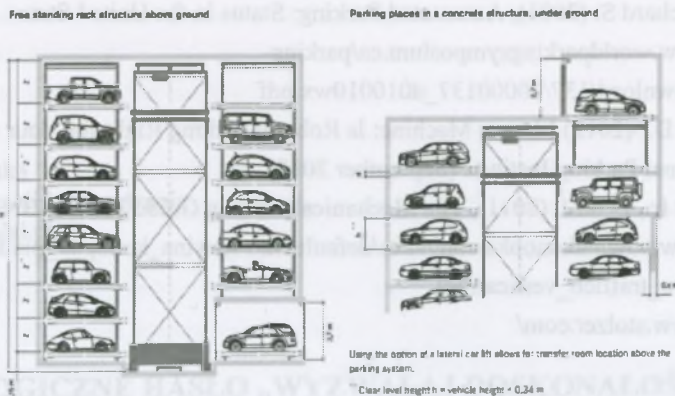


Fig. 10. Auto-UP system [10]
 Rys. 10. System auto-UP [10]

4. Conclusion

With the progress in technology the number of applications of automatics and electronics in construction also increases. This area is called intelligent housing.

Intelligent housing – this type of housing is inevitably associated with a building management system, and fields such as automatics, automation and high-tech architecture.

The automatic system is similar in action to a robotic car parking. The system retrieves the vehicle from the parking zone and transports it to the exchange zone, where using a turntable it is directed so that the driver does not have to reverse.

Semi-automatic systems are also based on systems of vehicles deployment, however, to set the vehicle in a parking zone or retrieve it requires participation of the driver.

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Omówienie

System zautomatyzowanego parkowania APS (ang. Automated Parking System) został stworzony po to, by zmniejszyć teren przeznaczony na parkowanie samochodów. Podobnie jak w przypadku parkingów wielopoziomowych, tak i w przypadku APS stosuje się metodę parkowania pojazdów w wielopoziomowych pionowych stosach w taki sposób, by ograniczyć wykorzystanie terenu przeznaczonego na parking przy jednoczesnym zapewnieniu maksymalnej liczby miejsc parkingowych.