TRANSPORT PROBLEMS 2008
PROBLEMY TRANSPORTU Tom 3 Zeszyt 3

Czesław PYPNO
Silesian University of Technology, Faculty of Transport,
Department of Logistic and Mechanical Handling
Krasińskiego St. 8, 40-019 Katowice, Poland
Corresponding author. E-mail: czeslaw.pypno@polsl.pl

MULTI-STOREY AUTOMATED OVER GROUND GARAGE FOR CARS – SOLUTION OF PARKING PROBLEMS IN BIG URBAN AREAS

Summary. In the paper there is a preliminary project of automated garage with capacity of 600 cars per hour in both directions. These garages can meet parking needs resulting from an increasing number of cars in developing urban areas.

WIELOKONDYGNACYJNY ZAUTOMATYZOWANY NADZIEMNY GARAŻ DLA SAMOCHODÓW OSOBOWYCH – ROZWIĄZANIE PROBLEMÓW Z PARKOWANIEM SAMOCHODÓW W DUŻYCH AGLOMERACJACH MIEJSKICH

Streszczenie. W referacie przedstawiono projekt wstępny zautomatyzowanego garażu o przepustowości po 600 samochodów na godzinę w dwie strony. Garaże takie będą zaspokajać potrzeby parkingowe, wynikające ze wzrostu liczby samochodów w rozwijających się aglomeracjach miejskich.

1. INTRODUCTION

The development of motorization has caused many social problems with parking and garaging cars especially in big urban areas. The necessity of supplying enough parking places near to city centres, shopping malls, big companies and airports result from legal regulations and urban development policy. Building multi-storey garages, at high land prices, gives possibility to park a car on a relatively small parking area [3]. It is essential that properly designed parking areas and garages enable the city to function, whereas improper designing may constrain the development of the city.

The first systems of mechanical parking were introduced in the USA in 1930s. Their origin resulted from a rising demand for parking areas and high prices of land in big city centres. At present, thanks to staffless, mechanical systems controlled by computers, it is possible to park or get one vehicle within 40-120 s. which is only 90-30 cars per hour. It means that the capacity of these garages is limited and they are used mainly in the places where the process of loading and reloading can take place slowly.

One of the characteristic quantities of these garages is the index determining [4]:

- the area of one parked car taking into consideration an overview,
- the area of one parked car taking into consideration the whole parking area,
- the cubature index.

In the designed garage the indexes are favourable and amount to W_1 = 1.10 m^2/1car., W_2 = 1.72 m^2/1car., W_3 = 58 m^3/car.

The index is the better the higher the garage is [4]. The article presents a preliminary project of an innovative solution to an overground, multi-storey, fully automated garage with capacity of 600 cars and possibility of fast loading and reloading - 10 cars per minute can be moved in both directions. Such a big capacity of the garage has never been met before.

2. A SHORT PRESENTATION OF AUTOMATED GARAGES

Automated garages

In both Europe and in the world there are overground automated garages shaped in a circular view (Fig. 1) [1], or rectangular view (Fig. 2) [1]. Both of them are equipped with electric or hydraulic lifts with a turn-table, which enables the car to be always put front towards the exit. The garages can even consist of 30 storeys and can house from a few dozen to a few hundred cars [6].

a) b)

Fig. 1. The automated overground garage: a) outside view, b) the projection
Rys. 1. Garaż zautomatyzowany nadziemny na rzucie prostokąta: a) widok z zewnątrz, b) rzut kondygnacji

3. STAFFLESS AUTOMATED GARAGE WITH CAPACITY OF 600 CARS PER HOUR IN BOTH DIRECTIONS

3.1. Short description of a load –bearing structure and some mechanical devices of the garage

The garage is designed on a rectangular view and it consists of 16 storeys, namely a ground floor and 15 floors. There are 40 parking places on each floor which means there can be placed 600 cars in one garage and makes it one of the big ones [2]. The load-bearing structure is made in a skeleton form

of steel rolling milled or bent profiles. There is a ceiling only between the ground floor and the first floor. The whole construction is placed on a concrete slab foundation in which there are canals/ pits for mechanical devices to be put in them. In the mechanical part on the ground floor there are conveyors for receiving and giving out the cars. The cars are transported on the pallets from the ground floor to particular floors by means of an electric lift. On each floor the cars are taken from the lift by a travelling platform and distributed to the parking places. Transport of the carts in the opposite vertical direction takes place by means of the second electric lift, which differs from the first one only in its drive because the working movement takes place downwards here. Fig. 3 shows the description of the garage.

a) b)

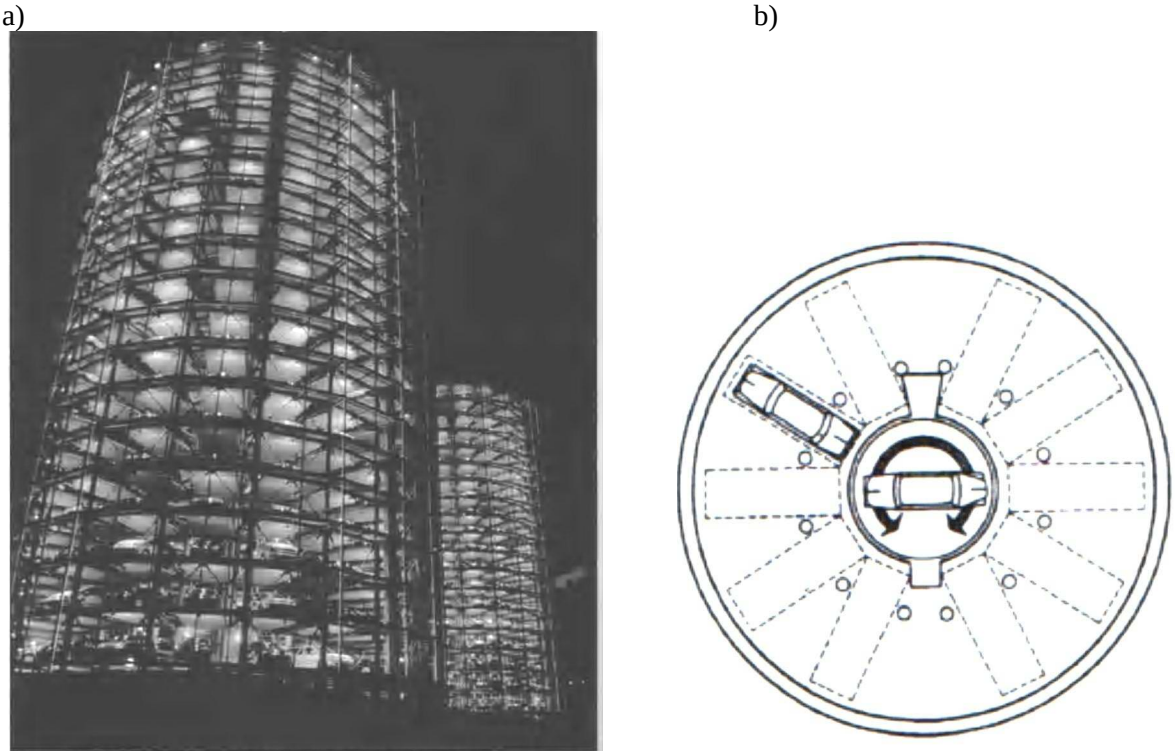

Fig. 2. 14-storey automated garage: a) outside view, b) lift with a turn-table
Rys. 2. Garaż zautomatyzowany na rzucie koła: a) widok z zewnątrz, b) dźwig obrotnicą

3.2. Cycle of taking cars into the garage

The staring position of the cycle is when the garage is completely empty. The garage has 10 in-drives onto the receiving platform where the drivers leave their cars. The max. time of receiving a car amounts to 60 s. Next, the lift transports the cars up and they are distributed on the platforms into the boxes. The lift closely cooperates with the platforms on the floors. With such a mobile/efficient work the garage is able to take in 600 cars within 60 minutes.

3.3. The cycle of giving out the cars from the garage

The starting position of the cycle is when the garage is full of cars. The drivers come to the passage in order to take their cars back. There are 10 entries onto the platform giving the cars. There is a display showing the plate numbers above each entry. The system works conversely to what was described in the previous chapter. It is possible that the garage gives out 600 cars within 60 minutes.

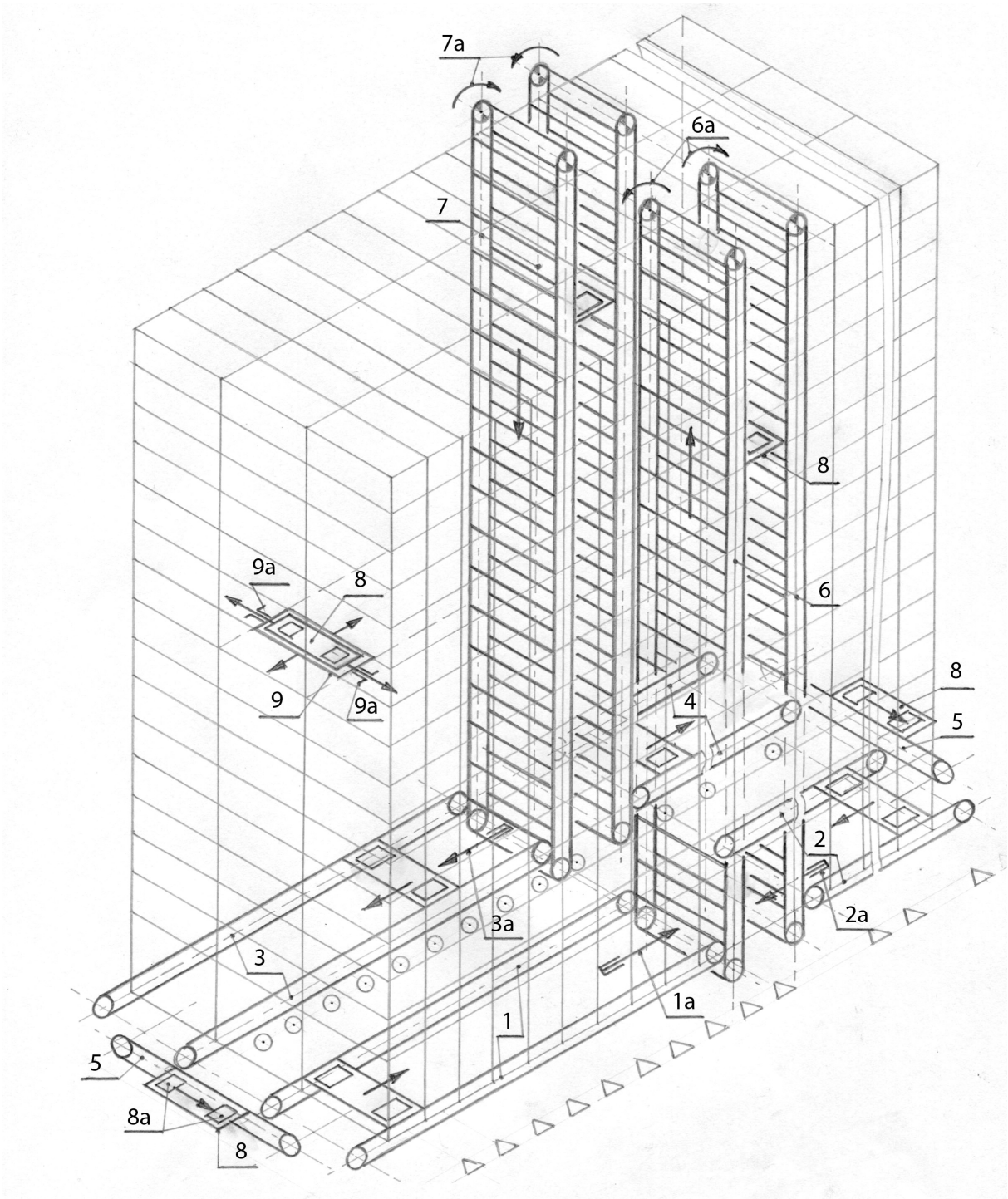

Fig. 3. Diagram of the designed garage with basic mechanical devices: 1 – left take-in conveyor, 2 – right take-in conveyor , 3 – left give-out conveyor, 4 – right give-out conveyor, 5 – halfway conveyor, 6 – lift conveyor, 7 – lowering lift, 8 – palette, 9 – platform

Rys. 3. Schemat projektowanego garażu z podstawowymi urządzeniami mechanicznymi: 1 – przenośnik odbierający lewy, 2 – przenośnik odbierający prawy, 3 – przenośnik wydający lewy, 4 – przenośnik wydający prawy, 5 – przenośnik pośredni, 6 – dźwig podnoszący, 7 – dźwig opuszczający, 8 – paleta, 9 – platforma

3.4. Simultaneous giving out and taking in the cars

Actions described in chapters 3.2 and 3.3 can take place simultaneously. The garage controlled by computer can take in and give out cars at the same time – 600 cars per one hour.

4. CONCLUSION

The number – 600 parking places was chosen at random. It is possible to design a garage with 720 cars taken in and given out per hour.

The presented garage has a very high capacity, which has never been met before, which can be very beneficial to the drivers who start and finish driving in the same place in rush hour.

It has been submitted to grant a patent for the invention: Multi-storey automated overground garage for cars.

Bibliography

1. Bell J.: *Car Architecture. When the car and the city collie*. Birkhauser-Publishers for Archtecture. Basel-Boston-Berlin. Londyn, 2001.
2. Michalak H.: Kształtowanie konstrukcyjno-przestrzenne garaży podziemnych na terenach silnie zurbanizowanych. Oficyna Wydawnicza Politechniki Warszawskiej. Warszawa, 2006.
3. Neufert E.: Podręcznik projektowania architektoniczno-budowlanego. Arkady. Warszawa, 2003.
4. Ryś J., Kasperek T.: Automatyczne parkingi wielopoziomowe. Transport Przemysłowy. 4/2004, Wydawnictwo Lektorium. Wrocław, 2004, s. 50-53.
5. Trusewicz T.: Zautomatyzowane parkingi samochodowe. Architektura-Murator. 10/1996.
6. Parkingi i garaże wielopoziomowe. MA-SKI auto parksystemy. www.maski.com.pl

Received 19.02.2008; accepted in revised form 24.09.2008