DESIGN ANALYSIS OF ROTARY CAR PARKING SYSTEM

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Abstract

In congested areas of metropolitan cities, parking has become a major issue, and we need a good parking system to deal with it. Various types of vehicle parking systems, such as Multi-level Automated Car Parking, Automated Car Parking System, Volkswagen Car Parking, and so on, are used around the world. The goal of this project is to design and develop a working model of a Rotary Automated Car Parking System that can accommodate up to eight cars. This system was put in place to reduce the overuse of land space, which is already in short supply in metro areas. The parking platform is driven by a chain and sprocket mechanism, and a motor will be used to power the system and index the platform. Individual car parking issues, particularly in urban areas, were already a problem for residents of developed countries during the interwar period. These issues will continue to arise as the number of cars on the road grows and parking spaces become scarce. The article discusses rotary car parks as one of the possible solutions (The Rotary Automated Car Parking System; RACPS). The research results mentioned in the article are the result of work done at the Cracow University of Technology's Faculty of Mechanical Engineering.

IndexTerms: Rotary parking system, smart parking system, parking spot, Taguchi method, typology of parking lots, reducing model of rotary parking lots, RACPS, parking system.

I. Introduction

In 1905, the first multi-level automated car park (APS) was built in Paris, with an elevator that transports cars to the appropriate level, where the employees parked their vehicles. Automated parking garages first appeared in the United States (New York) in the 1920s and have remained popular to this day. The so-called car towers are the most well-known car parks of this type in Europe. A car park in the Volkswagen plant in Wolfsburg, Germany, was built from two concrete silos that were once used to store grain, resulting in the TurmFahrt glass towers, which are car parks for cars leaving the production line.. Each one can hold 400 cars. They pass through an underground tunnel connecting the factory and the towers on their way to the silo. Both silos are open to the public. Visitors travel up and down through the center of each building in a glass gondola, or elevator. One of the town's main attractions is the sight of dozens of cars that appear to be suspended in mid-air. The largest automated car park in Europe is currently a 1000-car car park in Denmark.

Fig.1 Integrated car parking solution

Fig.2 Robot Car parking

Fig.3 Multilevel parking

Fig.4 Rotary parking system

The ability of nations to use and apply newly invented technologies in all aspects of life is a measure of their advancement and progress. Control engineering is one of the aspects to which many researchers have given a lot of attention. For nearly a century, planners, engineers, and environmentalists have grappled with the problem of where to put cars as the automobile's popularity grows. Innovative thinkers have attempted to devise clever ways to park vehicles ranging from the earliest parking garages renovated horse barns to fully automatic parking structures. India's rapidly growing urban population is causing a slew of issues for cities, with vehicle parking being one of the most pressing concerns. The parking space ratio in many urban housing societies is 1:1. To avoid these issues, many new technologies have recently been developed that aid in the resolution of parking issues to a large extent. The Rotary Automated Car Parking System (RACPS) is part of the smart car parking system category. Traditional parking systems, such as non-automated multilevel or multi-story car parking systems, robot car parking systems, automated multilevel car parking systems, and so on, have been widely implemented. However, these systems have a major drawback in that they take up a lot of space, which can be avoided by using a Rotary Car Parking System. Furthermore, the latter offers the advantages of flexibility in operation without the need for an attendant, as well as increased security and a lower risk of vehicle damage. The model is easy to assemble and dismantle due to the use of composite parts, making it more convenient than traditional car parking systems. The rotary model is designed to fit multiple cars in a horizontal space that can only fit two cars. The structure can hold six cars in the space of two, or it can be customized to hold a larger number depending on the needs of the user, and it can be used effectively in areas where space is limited. Even though automated parking, such as multilevel parking, has improved the situation slightly, there is still room for improvement. This is due to the fact that people still face issues with space, searching time, and waiting time in public places such as malls, multiplexes, railway stations, and shopping streets. The majority of these issues will be resolved thanks to new smart parking technology. Vehicles parked at random cause a major problem in most metropolitan cities, and after studying all of these systems, we discovered that the Rotary Car is the best solution.

II. Design of Rotary Car parking system

The technical solution for a multi-level, automated car park presented below is far ahead of existing solutions and addresses the issues raised in the car park literature. As a result, it: lowers the investment cost of a parking space several times; lowers the value of its total area indicator; lowers the average time of parking and unparking vehicles; significantly increases the reliability of its operation

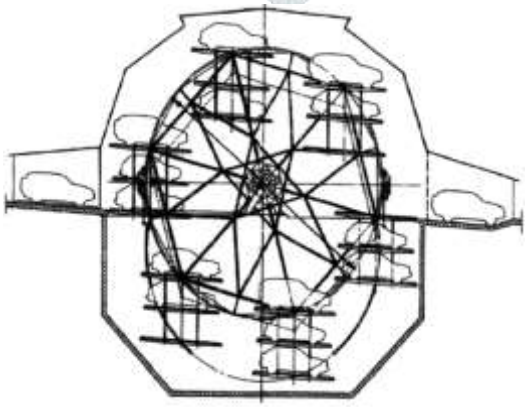

Fig. 5Rotary car park – an example of a solution

A car park that rotates around its horizontal axis is suggested. No internal access roads or ways are required because the car drives directly to the parking space. The gravitational system of moving vehicles (using the inclination of the transit area) does not require any mechanical devices or drives, and there are no ceilings, load-bearing walls, or pillars in this car park. It's easy to use, inexpensive, and dependable. The aforementioned platforms, together with hangers, rotatable mounted in the rotary drum sides, may be single or multi-level, with two cars on each level, depending on the car park size. The number of arms with platform hangers also determines the drum's size. The drum, which is supported by two poles, rotates, and cars enter and exit near half of its

height, in a plane perpendicular to the axis of rotation. As a result, the parking lot is partially recessed into the ground and partially raised above it.

Component required:

1. Ball bearing
2. Wiper motor 12v,10w
3. Roller frame
4. Frame for boxes
5. Switch mode power supply (SMPS)
6. Servomotor
7. Chain and sprocket

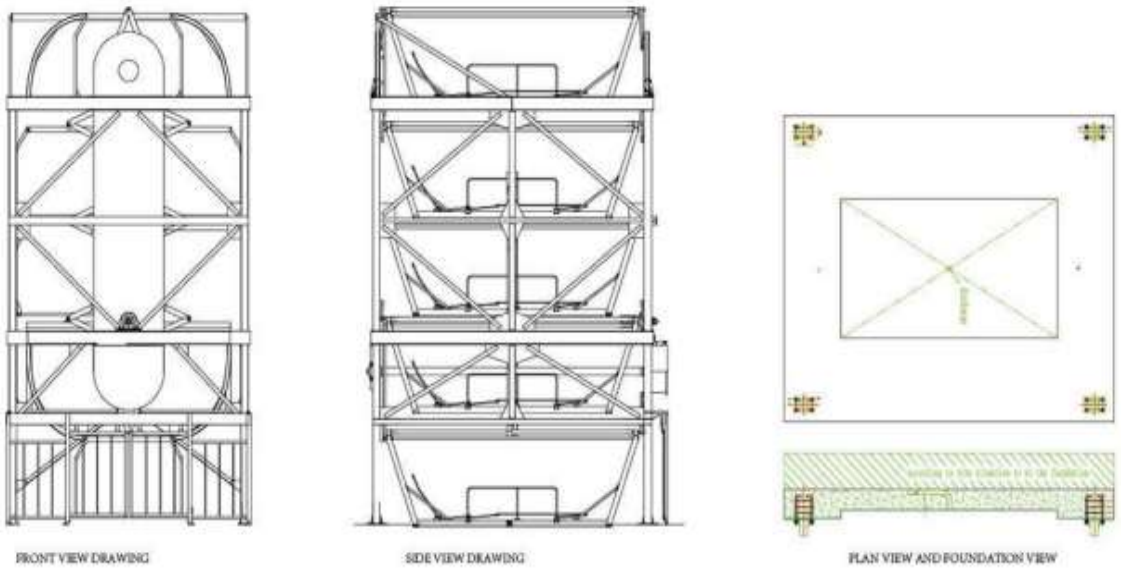

Fig.6 Top, Front and Side views of Rotary car parking system

2.1 Modeling of Rotary Smart Car Parking System Using CAD System:

There are some good reasons for using a CAD system to support the mechanical design function:

- To increase in the productivity.
- To get better the quality of the mechanical design.
- To uniform design standards. To create a manufacturing data base.
- To remove inaccuracies due to hand-copying of drawings and irregularity between Drawings.

It is a document that contains the production specifications for a part. Part drawings are typically drawn to get a clear idea of the model that will be produced. CATIA V5 R20 is used to create the part drawing for the entire frame, which includes all views. The components created in the part module are imported into the assembly module using the 'insert components' command, and then mated together to form the required assembly. The following are the various assembly views and the drawing generated in CATIA V5 R20.

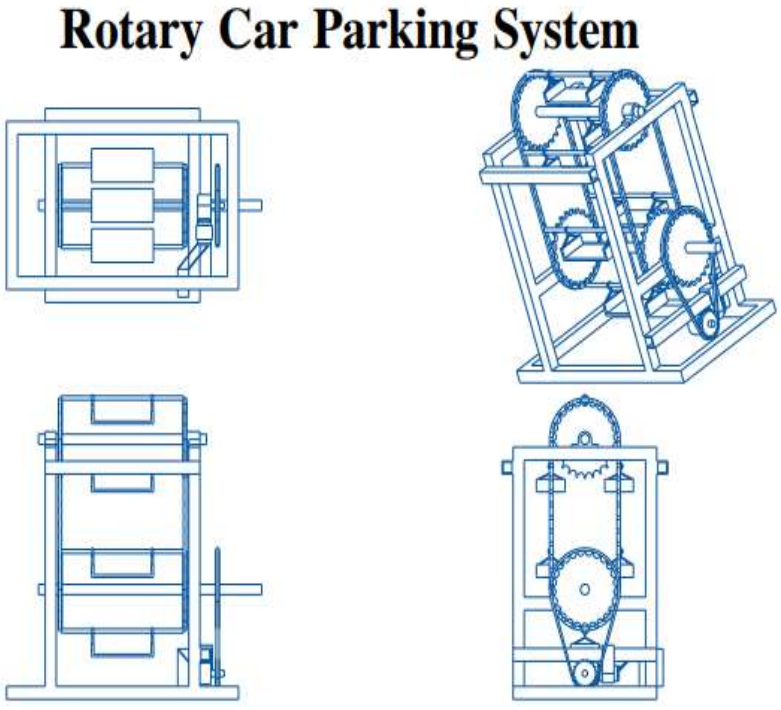

Fig. 7 ROTARY CARPARKING SYSTEMS

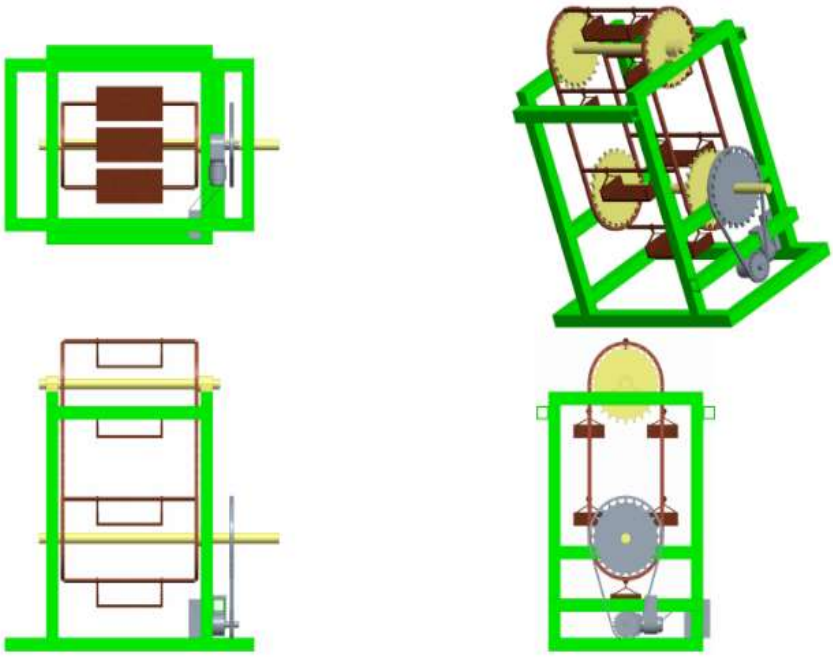

Fig.8 Model of Rotary Car parking system

2.2 Ball bearings

A ball bearing is a type of rolling-element bearing that uses balls to maintain the separation between the bearing races.

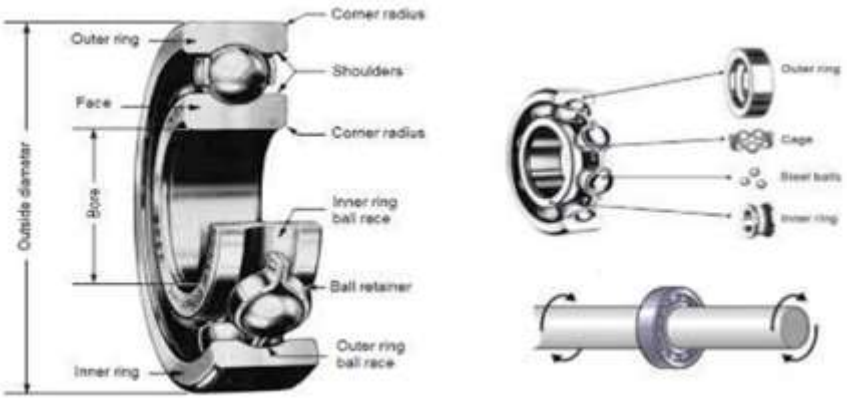

Fig.9 Ball bearings

A ball bearing's job is to reduce rotational friction while also supporting radial and axial loads. It accomplishes this by containing the balls and transmitting the loads through the balls using at least two races. One race is usually stationary, while the other is attached to the rotating assembly in most applications (e.g., a hub or shaft). When one of the bearing races rotates, the balls rotate with it. The balls have a much lower coefficient of friction than two flat surfaces sliding against each other because they are rolling. Wiper motors are components

of the wiper system that use electricity to move the wiper blades in a smooth motion. The wiper motor, like other motors, rotates in one direction continuously before being converted into a back and forth motion.

Fig. 10 WIPER MOTOR

A small electric motor, usually mounted on the firewall or under the cowl (the area beneath the windshield's base), drives the wipers. The motor moves the wiper arms back and forth by activating a linkage. When a vehicle has a rear window wiper, it is powered by a separate motor.

45 RPM DC Wiper Motor for Cars

Table 1 Specifications of used components

Motor Voltage	**12V**
Speed (Rpm)	45
Power (Watts or HP)	14
Rated Voltage	13.5 V
Current No load	1.5 A

2.1.3 Chain and Sprocket:

Chain drive is a method of moving mechanical energy from one location to another. It is frequently used to transmit power to a vehicle's wheels, particularly on bicycles and motorcycles. Aside from vehicles, it's found in a wide range of machines. The power is usually transmitted via a roller chain, also known as a drive chain or transmission chain, which passes over a sprocket gear, with the teeth of the gear meshing with the holes in the chain links. When the gear is turned, the chain is pulled, providing mechanical force to the system. The Morse chain, invented by the Morse Chain Company of Ithaca, New York, is another type of drive chain. This has teeth that are inverted.

Fig. 11CHAIN SPROCKET

2.3 ADVANTAGES AND APPLICATIONS

❖It ensures quick and automated parking and easy retrieval of vehicles.

❖Up to 6 cars can be easily and safely parked in the designed model.

❖The surface space required is equivalent to the parking space of two cars only.

❖Most suitable for parking in offices, malls and similar places.

❖The RACPS is engineered to ensure driver safety by use of an electronic safety zone.

❖Low maintenance levels are required by the system.

❖Does not require any parking attendant.

●It can be easily constructed in a small area, just requiring a simple concrete base and 3 phase electricity. By using modern technology, to design a system which will minimize land requirement, maximize efficiency and will be profitable in long term.

III. Conclusion

This automated car parking system can be equipped with safety features such as stopping the rotation of the platforms whenever there is human movement in the system, and the platforms can also be equipped with safety sensors that guide vehicle movement in the platforms. It can be fully automated by integrating it with a panel board, so that whenever a specific number on the panel board is called, the corresponding platform appears at ground level. This calling can also be made more secure by assigning a unique password to each platform, allowing the platform to be retrieved only when that password is typed. A turn table can be integrated with the system in front of the platform's ramp to allow cars to be easily turned and parked. This is particularly useful in areas where cars cannot easily turn to enter the platform.

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