Definitely the fastest way to get in-depth information about the technology and the
Including complete design manual and procurement tools.

The Mechanical Parking Guide 2011

Increase the number of parking places and the value of your real estate project

Ir. Leon J. Hamelink
The Mechanical Parking Guide 2011

Create Extra Parking Places and Value

The complete guide to mechanical parking systems. Contains an overview of all possible systems and a manual how to plan, design, realize and operate them. Furthermore the complete business directory with all manufacturers and resellers worldwide is included.
Acknowledgements

First of all thanks to my former employer, VDL Stokvis Parking Systems for their support. They have provided much information and images which has been extremely helpful. Do contact them if you have a project in or near The Netherlands, they deliver excellent quality and are basically nice people to work with.

And of course special thanks go to Inge and the kids who have supported me in writing this book in all thinkable ways and more. I love you all.

Furthermore thanks to all professionals and companies who have contributed directly or indirectly to the knowledge presented here. Every industry starts with the people in it, without them there would be no book.
About the author

Thank you for your interest in mechanical parking systems and the Mechanical Parking Guide.

My name is Leon Hamelink and I have been involved with mechanical parking systems for nearly 20 years now. I graduated at the Eindhoven University of Technology on this subject and with my small engineering company I have since then developed different mechanical parking systems for both cars and bicycles. During these years I have visited many manufacturers throughout the world, studied and procured their products, and was involved with the realization of many parking facilities using a variety of technologies.

In 2003 I started the mechanical parking department of VDL, a large industrial company in The Netherlands (7000+ empl.). And I am happy to say that VDL has been able to grow to gain a leading role in the Dutch market for mechanical parking systems.

At the end of 2010 I left VDL and I now focus on advising real estate developers, architects and government officials on the implementation and procurement of mechanical parking systems.

As you can tell I have seen just about all aspects of the technology and the business and my mission is to share this knowledge with all professionals in the construction business to help improve real estate projects through the use of these innovative systems.

Thanks again for your interest and I hope this guide will contain useful information for you.
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Focus and Outline

This guide is written for professionals involved with the development of real estate projects in an urban environment where space is scarce and the demand for parking places is high. It helps to:

- grasp the concept of different types of mechanical parking systems,
- determine whether these solutions are viable in their specific situations,
- plan and design a building integrating a parking system,
- procure these systems and
- set up service and maintenance properly.

Unfortunately, around the world projects can be found where applying mechanical parking has not been successful. Mistakes made in the planning, design and procurement process have occasionally led to systems with subpar performance and unsatisfied users. Although mechanical parking systems and the process to implement them correctly are quite complex, it is proven many times over it can be done properly. Based on almost 20 years of experience in this market, and seeing many things go wrong, I have described the step by step process to successfully implement these systems. Furthermore I will share all pitfalls I have seen and how to prevent them.

This information will also be valuable for people working in this industry, government officials and basically all people studying the market and the technology.

The structure of this book is based upon the phases of the real estate development process. In this context we identify the following stages:

<table>
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<tr>
<th>Phase</th>
<th>Part in this guide</th>
<th>Interested professional:</th>
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<td>F</td>
<td>Owner (User)</td>
</tr>
</tbody>
</table>

“Part A: Introduction” contains an introduction to the phenomenon of mechanical parking systems. After a short summary of the history it gives an overview of the different systems, their functionality, specific benefits and their main components. This part should be read by everyone interested in the subject to get a basic overview of the systems.
The second part; “Part B: Planning”, contains information to determine if and which of these systems are viable in your situation. It answers questions like:

- What systems are possible given the preconditions of a specific project?
- What types of system layouts can be considered?
- How will applying these systems affect the rest of the project?
- How to compare and select the optimal type of parking system?

“Part B: Planning” explains why and when mechanical parking systems should be applied. The main specifications; compactness and price per parking place are described and given for the main types of parking systems. Some typical layouts are shown for inspiration and finally the main pitfalls of the planning phase are described with proper countermeasures.

“Part C: Design” describes the functionality, specifications and the main components of all systems to the level of detail necessary for a good design of a building incorporating a mechanical parking system. Subjects are discussed like the parking process, traffic flow, legislation and standards, vehicle size and weight, performance level (speed), availability, noise and vibrations, safety, design for maintenance, construction details and integration with other electrical and mechanical building systems. Finally some attention is given to total cost of ownership.

“Part D: Procurement” helps to establish the right procurement approach. It helps you establish a procurement strategy fitting your situation. It gives practical guidelines for supplier selection and contract formation with among more things sample requirements and a decision matrix.

“Part E: Realization” informs the reader about the specific aspects to be taken into account during the construction phase. Both technical and managerial issues are addressed here.

The planning and execution of service and maintenance are dealt with in “Part F.: Service and Maintenance”. Types of maintenance, procedures, requirements and types of contracts are described here. Furthermore attention is paid to availability and remote functionality.

In the last part, “Part G: Market Situation”, attention is paid to the market situation around the world, and trends and analysis regarding technology and market.
Part A: Introduction
The world is undergoing the largest wave of urban growth in history. According to the United Nations Population Fund in 2008 for the first time more than half of the world population was living in towns and cities. By 2030 this number will swell to almost 5 billion.

As more and more parts of the developing world improve their standard of living, they adapt a lifestyle of mobility as has been known in the developed world for the last decades. So more and more people are living in highly urbanized regions and have the desire and the means to drive automobiles. This leads to parking places becoming more and more a scarce commodity with values rising as high as $200,000,- in densely populated cities like New York and London.

As long as there have been automobiles, people have been thinking about technical installations making it possible to park more vehicles in a given volume. This can be seen in Chapter 1: History, where a short overview of the history of mechanical parking systems is given. Developments are put in a historical perspective and the rise and fall of different technologies is described.

The essence of these mechanical parking systems is that a mechanical conveyor system takes care of at least a part of the transportation of the vehicle from the entrance of the parking facility to the parking place and back. The transport can be done fully-automatic or semi-automatic.

Fully-automatic means that no people are inside the vehicle or controlling the system during the transport. The installation operates computer controlled, unmanned and completely automatic.

The car is handed over to the parking system at the transfer cabin. An example of this can be seen in the picture on this page. As soon as the driver has left the car and instructed the system in the waiting area to park the car, the parking system secures all points of access to the system area and completely takes over the control of all movements in the system.

The main gate closes and a conveyor system will move the car to a parking place. To the right an example of such a conveyor system is shown. Upon the request of the user the car is move to exit again. All this will be operated automatically. Fully-automatic parking systems are described in more detail in Chapter 2: Fully-automatic Systems.
In semi-automatic parking facilities the user drives the car in the parking garage to a platform where he parks his car. When parked the users can leave the car and operate the system so that through the lifting and/or sliding of platforms more parking places become available. This way the capacity of a parking lot can be doubled or tripled while the general layout of the facility remains similar to a conventional situation. The picture to the right shows an example. Semi-automatic parking systems are described in more detail in *Chapter 3: Semi-automatic Systems*.

In order to avoid space consuming ramps one can apply car elevators. *Chapter 4: Car Elevators* contains information about car elevators, both with and without cabins.

Please keep in mind that this book is not about elevators in general. We assume that the reader is familiar with all things related to elevators for the vertical transport of people. This book only covers the aspects of elevators that are specifically relevant for the vertical transport of vehicles. For in-depth information about elevators in general please refer to specialized books on that subject.
Chapter 1: History

Looking back in history it seem that as long as there have been automobiles, people have been thinking about technical installations making it possible to park more vehicles in a given volume.

The oldest mention of a mechanical parking system I have found is the Garage Rue de Ponthieu in Paris by the architect Auguste Perret. The system was constructed in 1905 and transported vehicles to the first or second floor where they were parked by the attendant at either side of the corridor. Although this was basically a semi-automatic system, this layout is still surprisingly common in modern parking systems.

In the 1920’s some parking systems where constructed throughout the USA in cities like New York, Chicago and Los Angeles. They were mainly tower layouts of the paternoster (or Ferris wheel)-type like shown on the picture on the right (Chicago, 1937), and two and three-tier car stackers.

Throughout the USA Kent Automatic Parking Garages were built and used from the late 1920’s through the early 1960’s. They were public garages financed by the Kent Garage Investing Corporation of New York. One example is the twenty-eight story garage on Quincy Street in Chicago, Illinois, with 1200 parking places.

In the period up to the late 1950’s more than 70 systems have been built in the USA, particularly the so called “pigeon hole” type parking system by the Pigeon Parking Hole Corporation. A central elevator with an operator, capable of moving sideways through a corridor, parked the cars to either side of the corridor. Very often they offered amenities you would expect at a full service gas station. You could have your oil checked, your gas tank filled, your tire pressure checked and so forth. Some units are still in
operation today!

Also the less automatic systems designed by Richard Bowser entered the market in 1953 and gained a substantial market share.

Many of these systems operated for more than 20 years after which ever increasing land prices, mechanical problems and high maintenance costs led to demolition.

From the 1970’s more technically advanced systems were developed and build throughout Europe, Asia and Central America.

Especially in Japan mechanical parking systems have taken off since the early 1970’s. This was stimulated by the government by implementing tax laws promoting the realization of commercial parking facilities. The Paternoster type systems are very common there and annual production has been growing steadily up to the level of some 40,000 automatic parking places annually during the early 1990’s. Since then other types have gained more popularity like the shuttle tower and the simpler two-layered semi-automatic parking systems. Total annual production in the late 1990’s was well over 100,000 automatic parking places per year.

In Europe mechanical parking is gaining significant popularity more or less since the 1980’s. Production being focused in Germany and Italy the annual production seems to be steadily growing, although no accurate numbers are available. Technology has improved dramatically leading to faster and more reliable and user friendly systems.
Chapter 2: Fully-automatic Systems

2.1 Introduction

2.1.1 Basic Functionality

In a fully-automatic parking garage no people enter into the garage during operation. The driver leaves his car in a transfer cabin. Subsequently the main gate closes and a conveyor system will move the car to a parking place. Upon the request of the user the car is move to the transfer cabin again. All this will be operated automatically.

The main functionality, parking cars, can be broken down to the following sub-functions:

- Letting cars enter and leave the transfer cabin.
- Letting cars move from the transfer cabin to the parking place and back.
- Interacting with the user throughout the whole procedure.

Besides the main functionality, the system has the following sub-functions:

- Facilitating service.
- Facilitating management.
- Securing safety of the people and the cars.

2.1.2 Main Benefits

The main benefits of fully-automatic parking systems over traditional garages and parking lots, semi-automatic systems and car elevators;

- More cars can be parked in the same volume.
- Less space is needed for the same number of parking places.
- More flexibility in the shape of the volume used for parking.
- Lower total construction costs per parking place in highly urbanized situations.
- Cars are better protected against damage, theft and burglary.
- Users don’t have to drive through a traditionally difficult to navigate environment.
- Users don’t have to walk through a parking area that in many cases is regarded as unpleasant.
- The parking area can be designed with a lower standard regarding lighting, ventilation, accessibility and general level of finish.
- Easier on the environment regarding CO2, exhaust fumes and particulate matter because car engines are not running inside.
The main disadvantages of fully-automatic parking systems compared to traditional garages and parking lots, semi-automatic systems and car elevators:

- In case of a general failure no cars can enter or leave the parking facility.
- The systems need a reasonable amount of periodical service.
- Integrating these systems in the total project has many times proven to be challenging, technically and from a managerial standpoint.

### 2.1.3 Main Components

The main components of a fully-automatic parking system are:

- the transfer cabin,
- the waiting area,
- the storage system and
- the control system.

In the following sections these main components will be further described.
2.2 Transfer Cabin

Below you can see an image of a standard transfer cabin with some components which can be found in a typical situation.

A. Turning Device  
B. Main Gate  
C. Receiver Remote Control / Radio Frequency Identification System  
D. Traffic Light  
E. Side Door  
F. Car Dimension Scanners  
G. Working Area Door  
H. Motion Detectors  
I. Information Display  
J. Mirror  
K. Car Dimension Scanners

All of these components are described in more detail in section 11.3.

The transfer cabin is the place where the user hands over the car to the system. Its main function is to interact with the user, critical for the success of this fully-automatic system. The main dimensions of the car are checked here. Furthermore, because this area changes constantly from a safe area to a potentially harmful system area, safety features are vital.
2.3 Waiting Area

The waiting area is the place where users can give instructions to the system. Furthermore this is the place where users get informed what the system is doing and what is expected from them. It is located next to the transfer cabin, so it is visible from the waiting area.

The main components of this area are:

- Control panel with a display.
- Card reader or similar device for identification of the user.

The components of the waiting area are described in more detail in section 11.5.

2.4 Storage System

The storage system is the electro mechanical system that moves the car from the transfer cabin to its parking place and back. (Please note that in some systems you cannot really address a parking place to a specific car because the cars can and often will change location during storage.)

Storage systems can be divided into system with a corridor, we will refer to them as shuttle systems and systems without a corridor. These we will refer to as puzzle systems.

In these shuttle systems cars are transported to and from their parking place through a corridor with a transportation device we will refer to as the shuttle. Using a corridor has the obvious benefit of speed; the car can move relatively fast through the garage. But the corridor consumes quite some space.

Shuttle systems can be further divided into systems with pallets to park the car on and systems without pallets.

It is possible to create multiple rows behind one another at both sides of the corridor. In this situation it is possible that before a vehicle can be taken out, first other vehicles have to be moved. For this some parking places have to be left open. Although this is basically the same type of system, we pay some attention to this layout here because it greatly increases the compactness of this system. If you can apply the shuttle type system in this layout, it might just make mechanical parking viable in your situation.
This leads to the following overview of possible fully-automatic storage systems:

<table>
<thead>
<tr>
<th>With a corridor</th>
<th>With a corridor</th>
<th>Without a corridor, puzzle movement</th>
<th>Without a corridor, circular movement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single rows</td>
<td>Double rows</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>With pallets</strong></td>
<td><strong>Shuttle system, with pallets, single rows</strong></td>
<td><strong>Shuttle system, with pallets, double rows</strong></td>
<td><strong>Puzzle system</strong></td>
</tr>
<tr>
<td><strong>Without pallets</strong></td>
<td><strong>Shuttle system, palletless, single rows</strong></td>
<td><strong>Shuttle system, palletless double rows</strong></td>
<td><strong>Paternoster (or Ferris Wheel) system</strong></td>
</tr>
</tbody>
</table>

In the parking systems with pallets the user parks his car in the transfer cabin on a pallet, puts on the handbrake and leaves the car there. From there the parking system moves the pallet, and, with that the car, through the garage.

In the parking systems without pallets the conveyor system can move the car in one of the two following manners; either by grabbing the wheels of the car mechanically or by using conveyor belts.

In the first system the user parks his car on the floor of the transfer cabin, with the front wheels on a specially prepared positioning device. When the driver has left transfer cabin and activates the system, the shuttle locates and grabs the wheels of the car. In the parking place the car is placed on racks, specially formed to keep it in position, even when the handbrake is not used.
Palletless shuttle system can also use conveyor belts. With these systems conveyor belts are installed on the shuttle, in the parking places and in the transfer cabin. When the user has left the transfer cabin the conveyor belt starts moving the car.

The systems without a corridor move the cars on pallets through the garage.

In the first type, the puzzle systems, pallets can move independently of each other. Often many cars move at the same time and a few places are kept free of pallets to make movement possible. The motion reminds us somewhat of the promotional puzzles where by sliding you had to recreate the logo of the promoted company. That’s why we will refer to this system as the “puzzle system”.

In paternoster (or Ferris Wheel) systems the pallets are connected to each other so the order of them remains the same. When a car needs to leave the complete system rotates so the desired car becomes available in the transfer cabin.

These three types of systems are described in more detail respectively in section 12.1, 12.2 and 12.3.

The main components of the storage system are:

- Horizontal conveyor system
- Elevator (sometimes integrated with a horizontal conveyor system)
- Turning device (*) (often integrated in the transfer cabin)
- Centering device (**) (often integrated in the transfer cabin)
- Supporting framework

(*) Many times the system is also capable of turning the car so it can leave the garage driving forward.

(**) Sometimes the system is equipped with a centering device. This centers the car so it can be parked in tight spots, even when it is not parked straight by the driver in the transfer cabin.

These components are described in more detail in section 12.4.
2.5 Control System

*The control system* is the computerized heart of the garage which controls all of its activity. It is mainly situated in the control room, only accessible by authorized service personnel and facility management. It allows for people to intervene in the functioning of the system. This can be necessary in case of a malfunction, an error made by a user or in case of regular maintenance. Furthermore the control system can generate management reports, containing information like occupancy, patterns of use and availability.

*User service control terminals* are sometimes used for large public garages and office buildings. At these terminals trained service personnel can operate the system, giving it basic instructions like parking and retrieving cars.

The main components of the control system are:

- Control cabinet with PLC
- Service terminal (with graphical user interface)
- Remote service terminal
- Mobile service panel

These components are described in more detail in chapter 13.
Chapter 3: Semi-automatic Systems

3.1 Introduction

3.1.1 Basic Functionality

In semi-automatic parking facilities the user drives the car in the parking garage to a platform where he parks his car. When parked the users can leave the car and operate the system so that through the lifting and/or shifting of platforms more parking places become available. This way the capacity of a parking lot can be doubled or tripled while the general layout of the facility remains similar to a conventional situation.

The main functionality, parking cars, can be broken down to the following sub-functions:

- Letting cars enter and leave the storage system
- Creating access to other parking places by lifting and/or shifting one or more parking platforms
- Communicating with the user throughout the whole procedure

Besides the main functionality, the system has the following sub-functions regarding safety and management:

- Facilitating service.
- Facilitating management.
- Securing safety of the people and the cars.

3.1.2 Main Benefits

The main benefits of semi-automatic parking systems over traditional garages and parking lots:

- More cars can be parked in a given volume.
- Less space is needed for a given number of parking places.
- More flexibility in the shape of the volume used for parking.
- Lower total construction costs per parking place in highly urbanized situations.

The main benefits of semi-automatic parking systems over fully-automatic parking systems:

- Lower total construction costs per parking place
- The general layout of the facility remains similar to a conventional situation

The main disadvantages of semi-automatic systems over traditional garages and parking lots:
• Using the system takes a little training and put responsibility in the hands of the user regarding safety. Therefore these systems are not suitable for public use by inexperienced, untrained users.

The main disadvantages of semi-automatic systems compared to fully-automatic parking systems and car elevators;

• The working area needs to be accessible for users so it is less compact and needs better lighting, ventilation and general level of finish
• Using the system takes a little training and put responsibility in the hands of the user regarding safety. Therefore these systems are not suitable for public use by inexperienced, untrained users.
• Cars are not protected against damage, theft and burglary

3.1.3 Main Components

The main components of a semi-automatic parking system are:

• The waiting area
• The storage system
• The control system

The waiting area is the place where users instruct the system to make a parking place available if it is not already is.

The storage system is an electromechanical system with lifting and/or shifting platforms on which the users can park their car.

The control system handles all instructions by the users and controls the conveyor system. It is usually located in a wall mounted industrial cabinet near the parking system.

All of these components are described in more detail in the following paragraphs.

3.2 Waiting Area

The waiting area is the place where users can give instructions to the system. Furthermore this is the place where users get informed what the system is doing and what is expected from them.
If it is located next to the parking place the user can visually check if it is safe for the system to start moving. The only component in this situation is button panel, usually with a key switch to prevent unauthorized use.

The waiting area can be centralized to a single location in the parking facility if fences around the storage system are used to guard other users from harm during operation. In that situation there always needs to be a button or something similar near the parking place with a good overview of the situation to shut the gate after use and to make sure no people are trapped within the gates.

The main components of this area are:

- Control panel with a display or indication lights.
- Key switch or similar device for identification of the user.

These components are described in more detail in section 14.3.

### 3.3 Storage System

The essence of the storage system is that by lifting, shifting or a combination of lifting and shifting, of one or more parking platforms extra parking places can be made available to park on.

If lifting is involved, a distinction is made between systems that need a pit for platforms with a car to be lowered in, and systems that do not use a pit.

Systems are available with the following number of parking layers:

- One layer (shifting platforms)
- Two layers
- Three layers

More layers are possible but that type of system is not so common.
It is possible to create multiple rows behind one another on one side of the driving lane. To get to parking place behind the first row(s) a path is created by lifting and/or shifting the platforms in the blocking row(s). Although this is basically the same type of system, we pay some attention to this layout here because it greatly increases the compactness of this system.

This leads to the following overview of semi-automatic parking systems:

<table>
<thead>
<tr>
<th>Pit:</th>
<th>Layers:</th>
<th>Single row:</th>
<th>Multiple rows:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without (*)</td>
<td>2,3 or more</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lifting:</td>
<td>With 2,3 or more</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shifting:</td>
<td>Without 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Without</td>
<td>2,3 or more</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lifting &amp; Shifting:</td>
<td>With 2,3 or more</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(*) There are systems from which cars can leave without first having to manually remove other cars first from the system, so called independent systems, and system from which you sometimes do have to remove other parked cars first to get your car out. The latter we call dependent systems. Of course wetter they are dependent or independent systems often depends on the layout, except for the lifting systems without pit, so called car stackers, they are always dependent. In these systems the lower car has to leave for the upper car to get out.

The examples shown are explained in more detail in chapter 15.
3.4 Control System

The control system of a semi-automatic parking system is much less complex than that of a fully-automatic parking system. The simplest systems contain no Programmable Logic Controller (PLC); they are basically controlled by the user-operated key switch. If a PLC is applied it is usually located in a wall mounted industrial cabinet near the parking system.

All other control options of fully-automatic parking systems like a mobile service control panel, remote service control panel and a user service control terminal are usually not present. For a description of those please check chapter 13, covering the control system of fully-automatic systems.
Chapter 4: Car Elevators

4.1 Introduction

4.1.1 Basic Functionality

Car elevators are used to move vehicles from one floor to another by means of hoisting a platform on which the car can be placed.

We can identify three different types of car elevators, based on differences in safety concepts.

Car Elevator with a Full Cabin.

People allowed on the platform during transport.

People drive on the platform with their car. The doors close and the user presses a button to command the system to go to the desired floor. There the door opens and the user drives his car out. This is basically a similar elevator as used for the transportation of people with all the same safety features but with a bigger cabin suitable for handling vehicles.

Car Elevator with an Open Platform, People on Board.

People allowed on the platform during transport, required to use a “hold-to-run” device.

When less safety features are available it is sometimes necessary that the user stays in the car and activates a “hold-to-run” device through his opened window during transport. This for example allows for not to create a complete cabin on the platform to protect the user. The car is basically the cabin protecting the user in this concept. This makes for cheaper elevators.

Car Elevator with an Open Platform, no People on Board.

No People allowed on the platform during transport.

With this concept people park their car on a platform. They leave the car and go to a control panel. At the control panel they command the system to start moving with some sort of “hold-to-run” device. When the car has arrived at the desired floor the user has to go to that level by other means, for example a staircase or an elevator for the transportation of people. Then they can remove the car from the platform.
4.1.2 Main Benefits

The main benefit of a car elevator over a traditional ramp is that it takes up less space. This allows for more parking places to be created or more space becoming available for other functions at ground level. Furthermore, there are situations where a ramp is not possible because of the limited space available or the vertical distance is too high. Then car elevators are the only option.

Compared to other types of mechanical parking systems, it has the advantage that most users are familiar with using elevators, so acceptance of this solution is usually no problem.

4.1.3 Main Components

The main components of a car elevator are:

- The waiting area
- The platform
- The drive system
- The control system

4.2 Waiting Area

The waiting area is the place where users instruct the system to bring the platform to his floor if it is not already there. Furthermore, this is the place where users get informed about what the car elevator is doing and what is expected from them. So at each floor there is a waiting area.

The main components of this area are:

- Control panel with a display or indication lights.
- Push button or remote control receiver.

4.3 Platform

The platform is the place where the car is parked during transport. It can be an open platform moving in between the shaft walls, or it can have some sort of cabin, protecting the car and the user.

There is a control panel with functionality for controlling the car elevator, safety and communication.
4.4 Drive System

The drive system is an electromechanical or hydraulic system that propels the platform.

The drive mechanism can have the following concepts:

- Traction, usually based on an electrically driven drum with cables.
- Rack and pinion, usually electrically driven
- Hydraulic pistons, support the platform directly or indirectly using ropes
- Scissor mechanism

4.5 Control System

The control system handles all instructions by the users and controls the car elevator. Furthermore it monitors the safety circuit and stops the elevator in case of any hazard.

It is usually located in a wall mounted industrial cabinet near the parking system.

These components are described in more detail in chapter 16.
For All Professionals Involved With Mechanical Parking Systems:

Mechanical Parking Guide 2011

Planning.... Design.... Procurement

The Mechanical Parking Guide 2011, available as PDF, is an extensive guide for the planning and design of projects incorporating a mechanical parking system. It contains advise and tools for the procurement, realization, service and maintenance of these systems. Furthermore it provides an in-depth analysis of the mechanical parking industry worldwide and all the available systems.

The report was written for architects and real estate developing professionals and organizations worldwide. It provides all aspects relevant for the planning, design, procurement, realization and operation of these systems. Among the groups that will find it useful are company owners, executive management, engineering managers, engineers, advisers, system manufacturers, researchers, educators, the investment community, analysts, and the media.

The report was developed with support from numerous advisers, system manufacturers, and many others worldwide. To support the review and analysis, the publication includes 10 charts and graphs, 30 tables, 213 photographs and illustrations, and two appendices. This study has the aim to cover all facets of mechanical parking, including business, product, market, technology, research, and application.

This over 300-page color PDF includes:

- Technology overview and sample projects
- A complete design manual
- Procurement tools like cost indications and sample requirements
- List of all manufacturers and distributors worldwide
- New developments and market analysis
- Insight in what the future holds

If you are not 100% satisfied we will refund the complete amount, no questions asked!