



# Mechanical Parking Solutions for Modern Urban Density



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Credit for this course is 1 AIA HSW CE Hour



# An American Institute of Architects (AIA) Continuing Education Program

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# An American Institute of Architects (AIA) Continuing Education Program

Course Format: This is a structured, web-based, self study course with a final exam.

Course Credit: 1 AIA Health Safety & Welfare (HSW) CE Hour

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# INTRODUCTION

objectives – what? – why? – how?

# Course Description

An innovative solution to parking space, mechanical parking and the dependent access parking stackers' uses and limitations are illustrated and described in this course to expand your knowledge on this unique product. Learn about the different types of parking stackers and how they work.

# Learning Objectives

Upon completion of this course, you will be able to:

- Define mechanical parking
- Describe dependent access parking stackers' uses and limitations
- List the different types of independent access parking stackers
- Explain puzzle lifts, how they work and what their advantages are
- Describe fully automatic machines and why they might be used
- Compare and contrast the different stackers and lifts and describe when each would be appropriate for use
- Describe what type of cars are suitable for each lift
- Describe the design requirements for each parking type

# What is Mechanical Parking?

- Mechanical Parking encompasses a wide range of options all designed to increase parking density and cut costs over traditional parking methods.
- The solutions start at simple stackers, where the bottom car must be moved to get to the top car (dependent access) and go up to fully automatic machines where cars can be stored and retrieved from a single point of access.
- There are 5 mechanical parking typologies: dependent access stackers, independent access stackers, puzzle lifts, pallets and fully automatic parking machines.



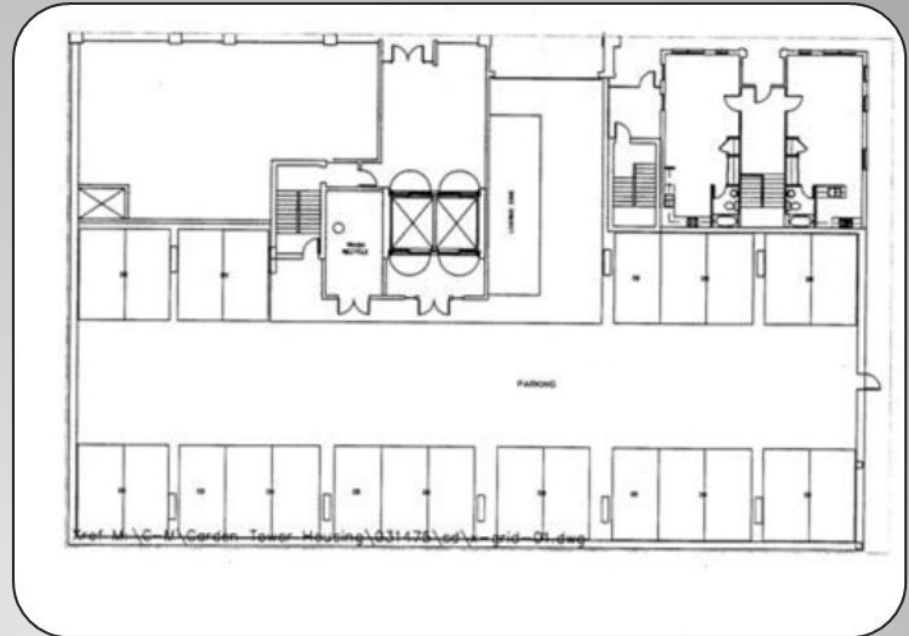
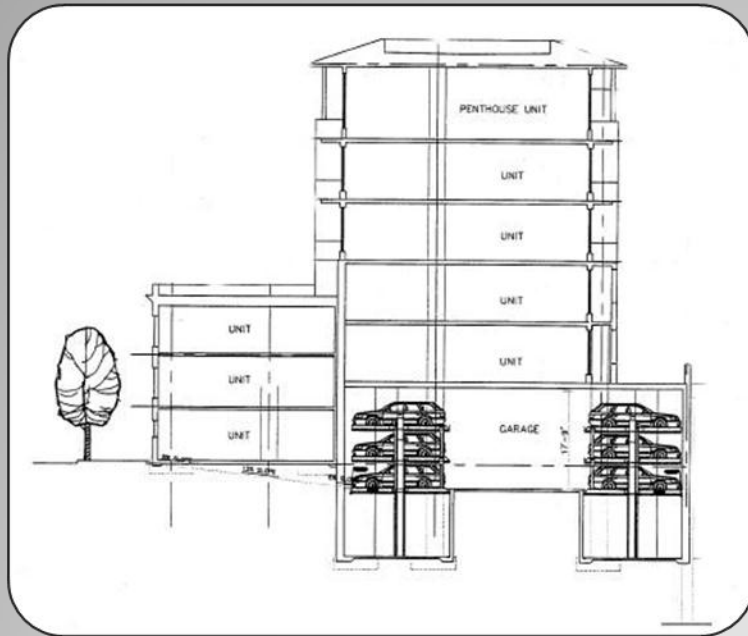


# Why Mechanical Parking Systems?

- 1. Excavating a conventional basement is expensive and sometimes difficult. If you need to dig down and add a level or levels, mechanical parking will save money.** A parking stall in a stacker generally costs between \$5,000 - \$20,000 depending on model and quantity, compared with \$35,000 for a ground-floor space and \$50,000 for a stall built underground in urban areas.
- 2. Parking machines can compact the cars as much as possible to create free space at ground level for retail areas or other higher uses.** A normal parking stall requires around 300 to 350 square feet. That allows for the stall and a modest amount of circulation and drive aisles; where as with a mechanical parking system, this dimension is closer to 200 square feet per stall, reducing area usage by 1/3.
- 3. Mechanical parking systems can increase parking capacity as much as possible to add value to the building.** Providing additional parking can frequently add value to units.



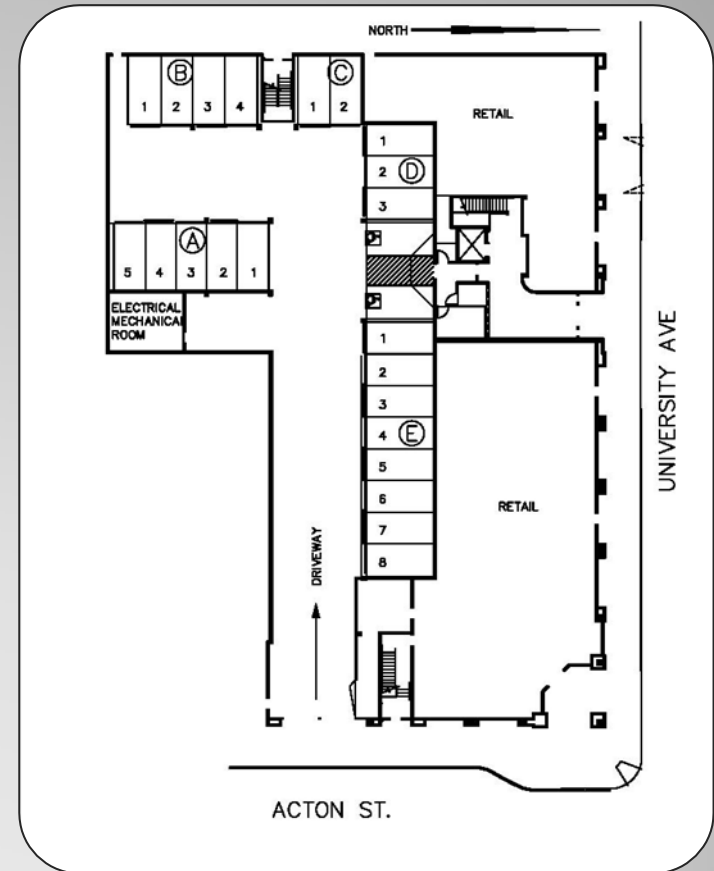
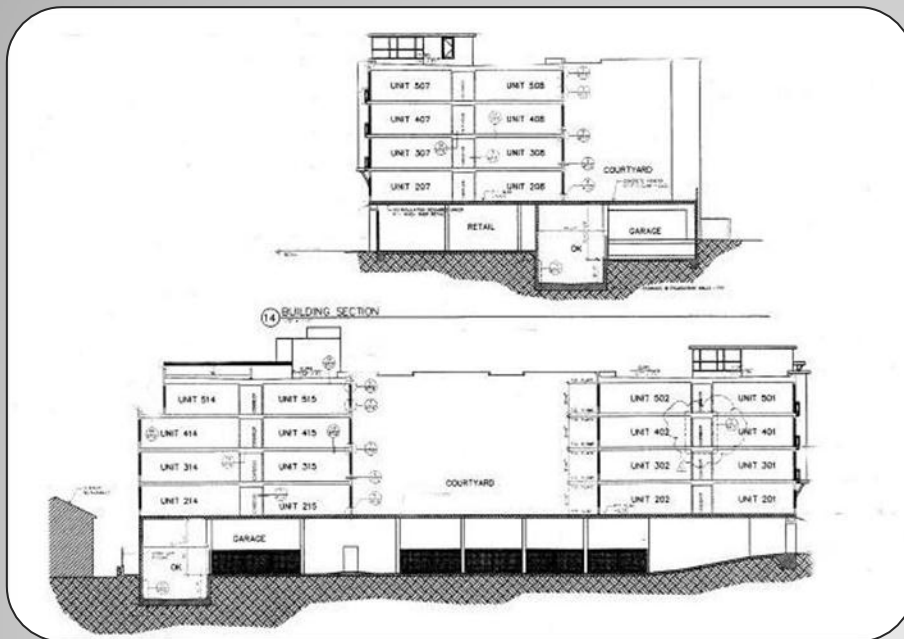
# Design Example



**72 Cars + 50 Units:  
Minimum Excavation, No Ramps**

# Design Example

More space on ground floor for retail



**61 Cars, 71 Units + Retail**

# Mechanical Parking Typologies

DEPENDANT ACCESS STACKERS

low ceiling – two high – three high

INDEPENDENT ACCESS STACKERS

sloping – double – triple

PUZZLE LIFTS

PALLETS

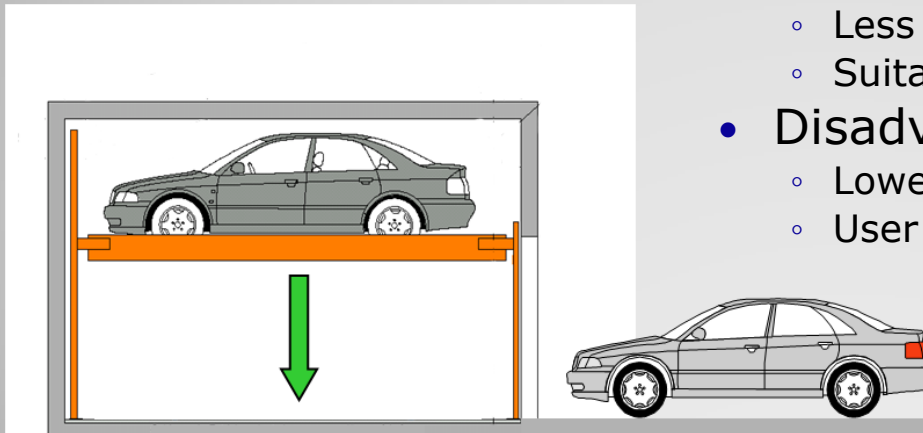
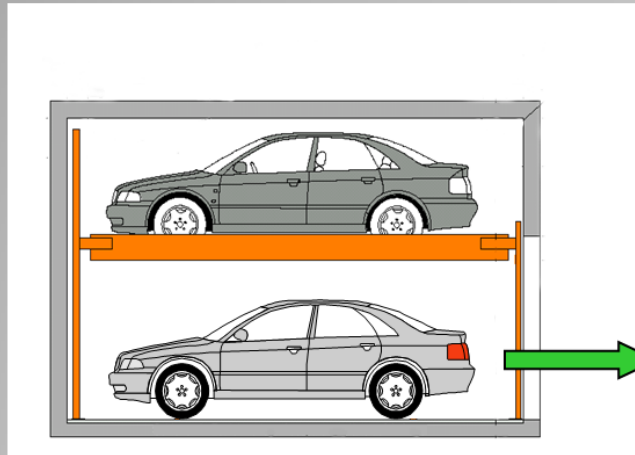
FULLY AUTOMATICS



## DEPENDANT ACCESS STACKERS

low ceiling – two high – three high

# Dependent Access Stackers



- Dependent parking means that the lower car or cars must be moved by the user to access the top car.
- This solution works well if both vehicles are for one unit or if there is a valet.
- Advantages
  - Low Cost
  - Can be installed in existing buildings
  - Low ceiling height (as low as 9'-4")
  - No pit required
  - Less than 60 seconds to retrieve car
  - Suitable for outdoor use
- Disadvantages
  - Lower car must be moved by user
  - User must have keys to both vehicles

# Dependent Access Models Overview



**Low Ceiling Model**

As low as 9'-4"



**Standard Two High**

Ceiling height min 10'-6"

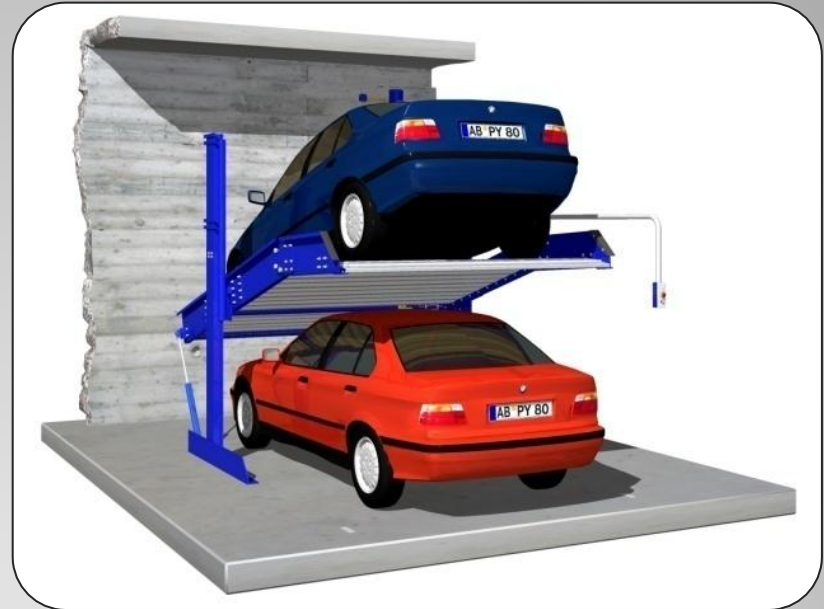


**Three High**

Ceiling height min 18' - 3"

# Low Ceiling Height Stacker

- This model takes advantage of the fact that a passenger car has a hood and a trunk to provide a ceiling height of only 9' – 4".
- Suitable for passenger cars only.
- Can be used outdoors





# Standard Two High Stacker

- The standard model is useful in areas where the ceiling height is not restricted. While the minimum ceiling height is 10' – 6", the height of the platform is adjustable and can accommodate SUV's if the ceiling is higher.
- Typically used in apartments or condos where both cars on the lift are for the same unit.
- A very popular model for valet use. The upper lifts are usually reserved for longer term parking and the bottom space for short term parkers



# Two High Stacker Examples



**Santa Monica, CA**



**Lafayette, CA**



**New York, NY**



**Emeryville, CA**

# Three High Stacker

With this version, two cars must be moved in order to get to the top car. It requires a ceiling height of 18' – 3" and is generally used outdoors with a valet or for car storage.







# INDEPENDENT ACCESS STACKERS

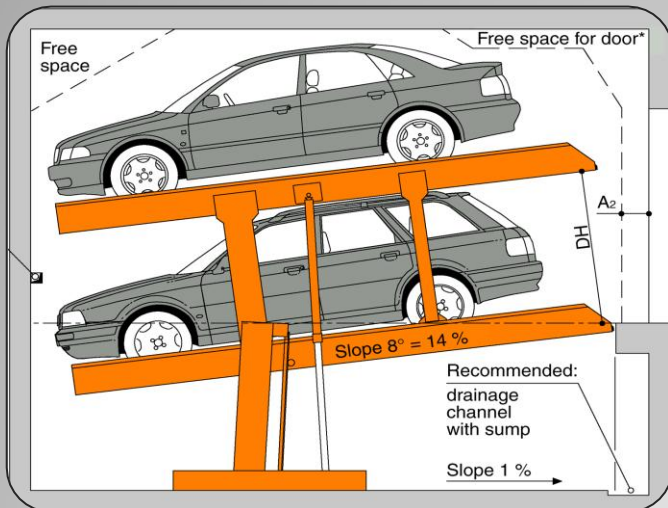
sloping – double – triple

# Independent Access Stackers

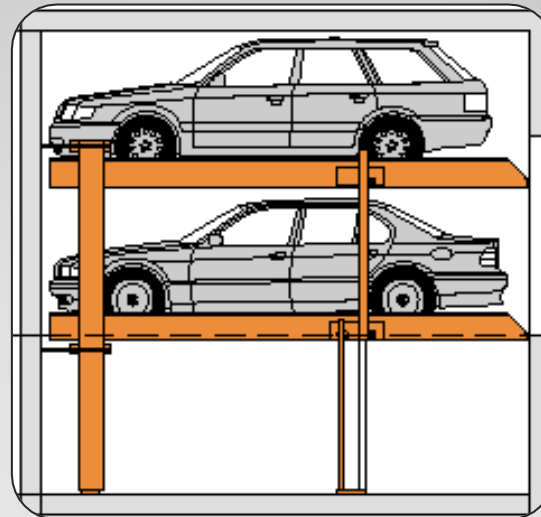
- Independent Access Stack Parkers require a pit, the bottom car is lowered into the pit so that the top car(s) can be driven off
- Advantages
  - No cars need to be moved
  - Simple operation
  - Less than 60 Seconds to retrieve a car
  - SUV's possible depending on model
  - Cost effective
- Disadvantages
  - Doesn't make the most efficient use of space (see puzzle lift)



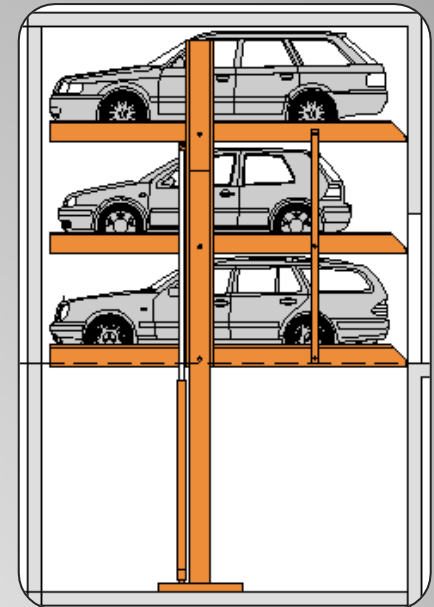
# Independent Access Stackers



**Sloping**



**Double**



**Triple**

# Two High Stacker with Pit



**The left and right pictures are of the same machines, one in the down position , the other in the up position**





# Two High Stacker with Pit



4 Cars- San Francisco

# Three High Stacker with Pit

- The three high stacker lowers one or two levels into the pit in order to provide independent access for each level.
- Advantages
  - Very Dense
  - Cost effective
  - Available as a single wide or double wide
- Disadvantages
  - Requires 15' – 9" ceiling and 10' – 10" pit
  - Passenger cars only
  - Low head room for user



# General Design Information

## Electrical

- Generally only a 208v 3 phase 30 amp circuit is required for each group of lifts (a few three high models require 40 amps). 220v single phase is also available for most lifts.
- Utility costs to run the lifts are usually quite low due to the fact that each lift is typically run just a few minutes per day.

## Sprinklers

- Most communities will require sprinklers on each level of the machine and in the pit, if the machine has one.

## Seismic

- If the lifts are to be installed in a seismic zone they may need to be braced to a wall or column.
- The lift manufacturer must be able to provide the structural loads associated with the earthquake zone and recommendations on any bracing requirements.

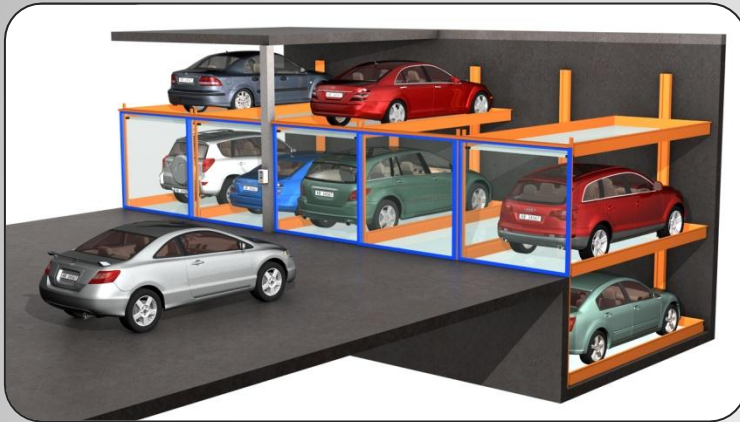


# PUZZLE LIFTS

two high – three high – combination

# Puzzle Lifts

Puzzle lifts provide independent access to all cars parked on the system. The machine must be accessed at each individual parking bay from the drive aisle. The parking spaces are arranged on two or three levels. The upper and lower level parking spaces move vertically and the middle parking spaces move horizontally (left and right) to allow upper or lower level cars to come up or down to driveway level and be driven off the platforms. The middle level of the machine has one less car than the upper and lower level to enable the lower cars to move left and right to create the vacant space.





# Puzzle Lift Two High

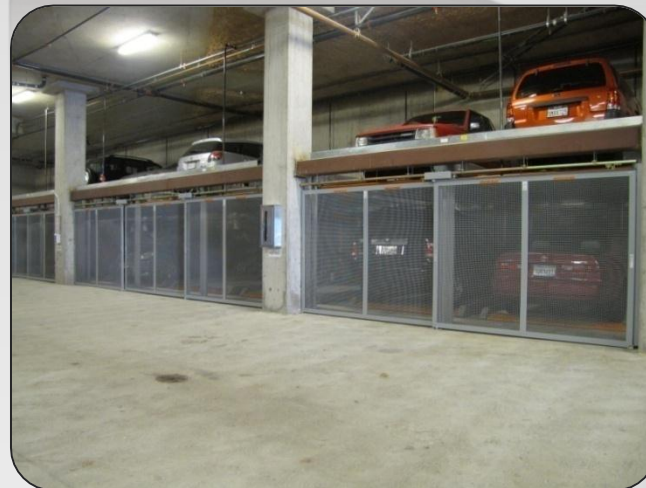
- The two high puzzle lift provides independent access and does not require a pit. The minimum ceiling height is 11' – 4". However it does require one empty slot in each module. It is available from two wide (holds 3 cars) to 15 wide (holds 29 cars).

## Advantages

- Independent access
- Can accommodate SUV's
- No pit required, can be used on upper levels of a garage
- Almost doubles the amount of parking in the same space with no excavation

## Disadvantages

- More expensive than simple stackers



# Two High Puzzle Lift Animation

Video available in online format only





# Three High Puzzle Lift

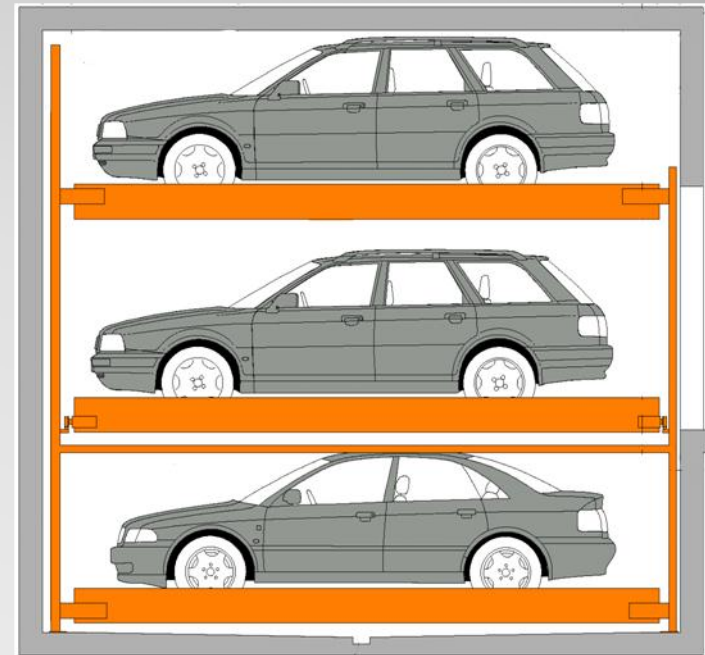
- Makes the best use of available space. With a minimum ceiling height of 11' – 4" and a pit depth of 5' – 7" the machine can almost triple the number of cars in a parking area with minimal excavation. It is available in modules from 2 wide (holds 5 cars) to 10 wide (holds 29 cars)

## Advantages

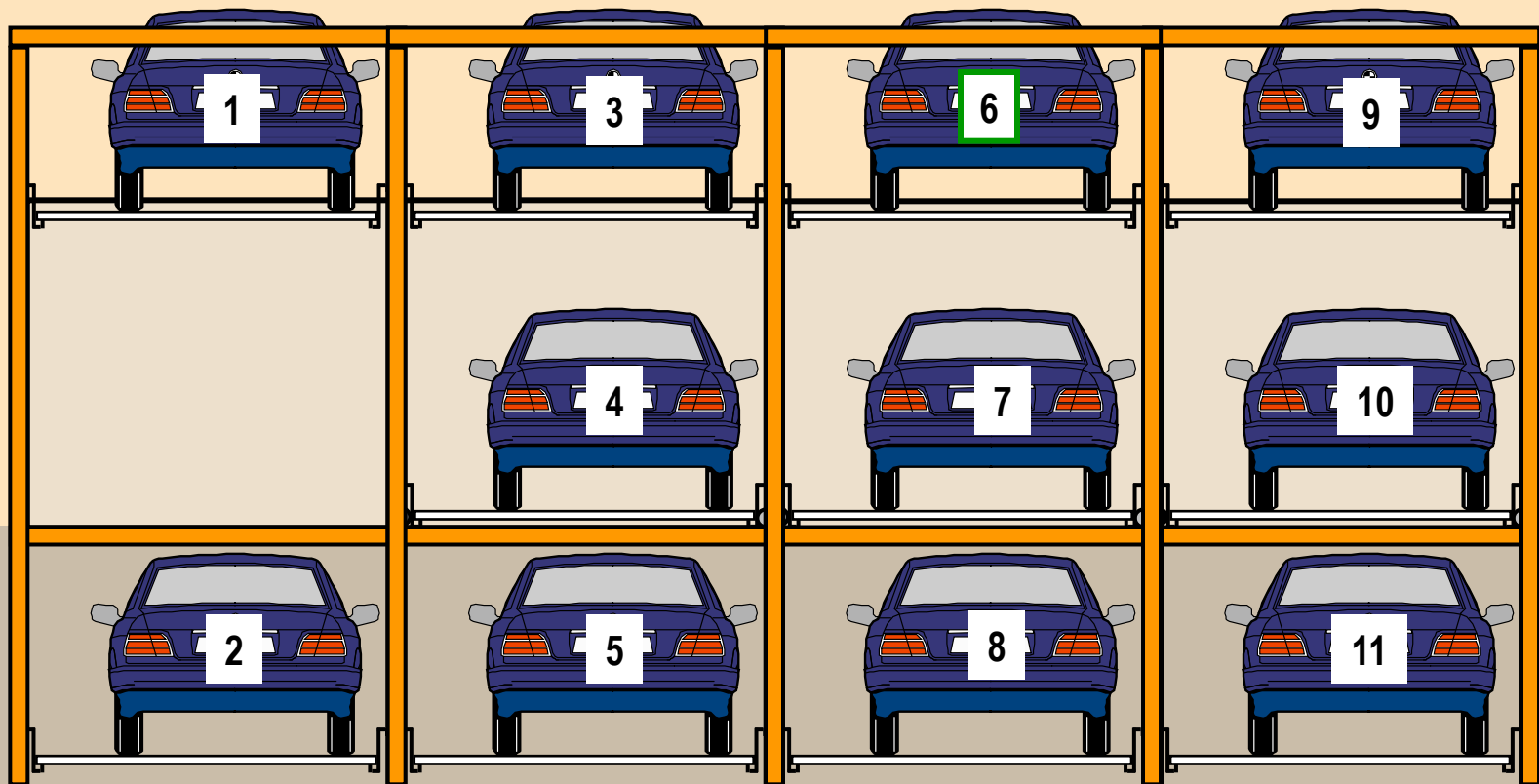
- Independent access
- Very dense - Almost triples the amount of parking with minimal excavation
- SUV's can be accommodated with a slightly higher ceiling height and deeper pit.

## Disadvantages

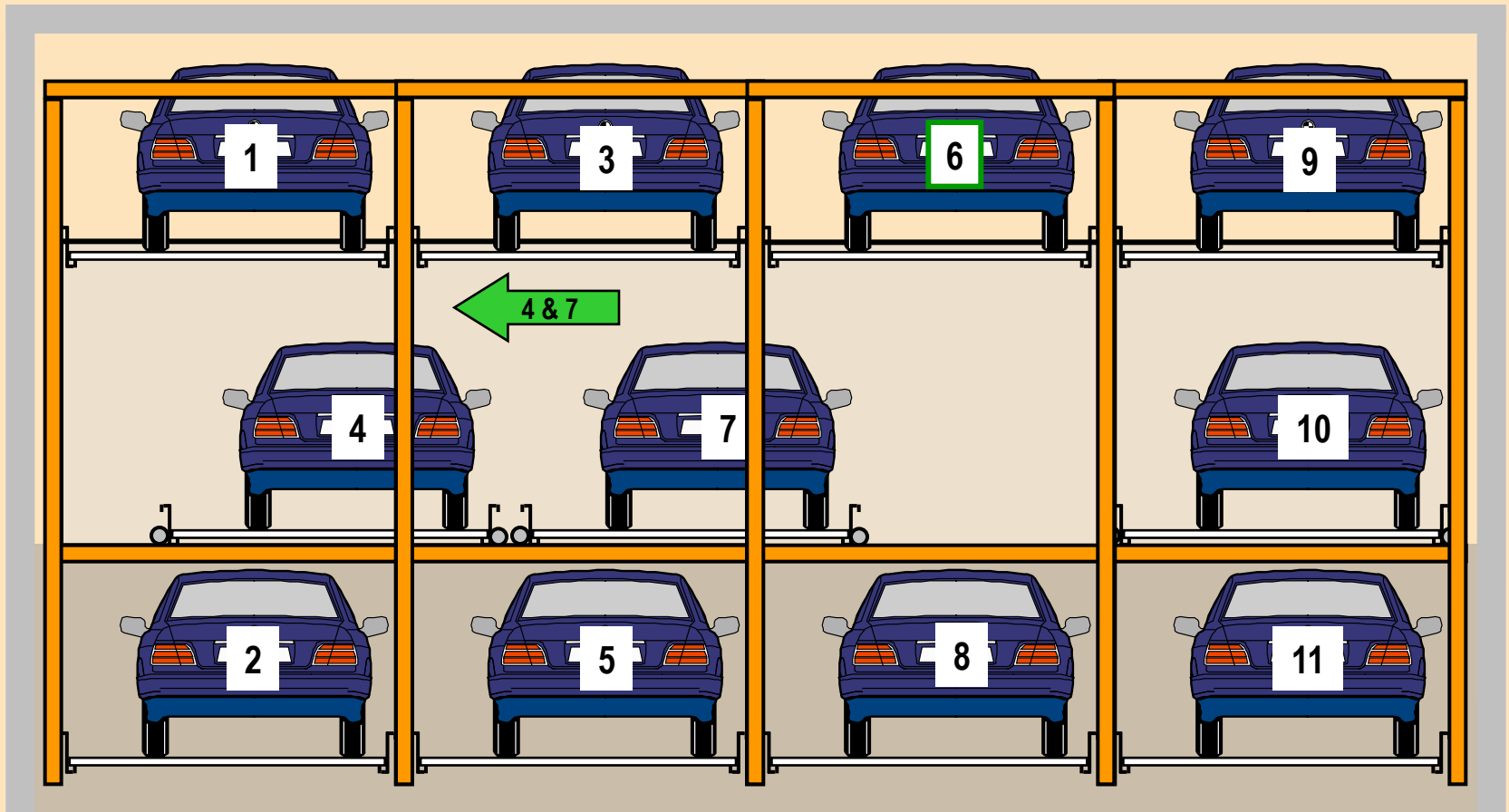
- More expensive than simple stackers



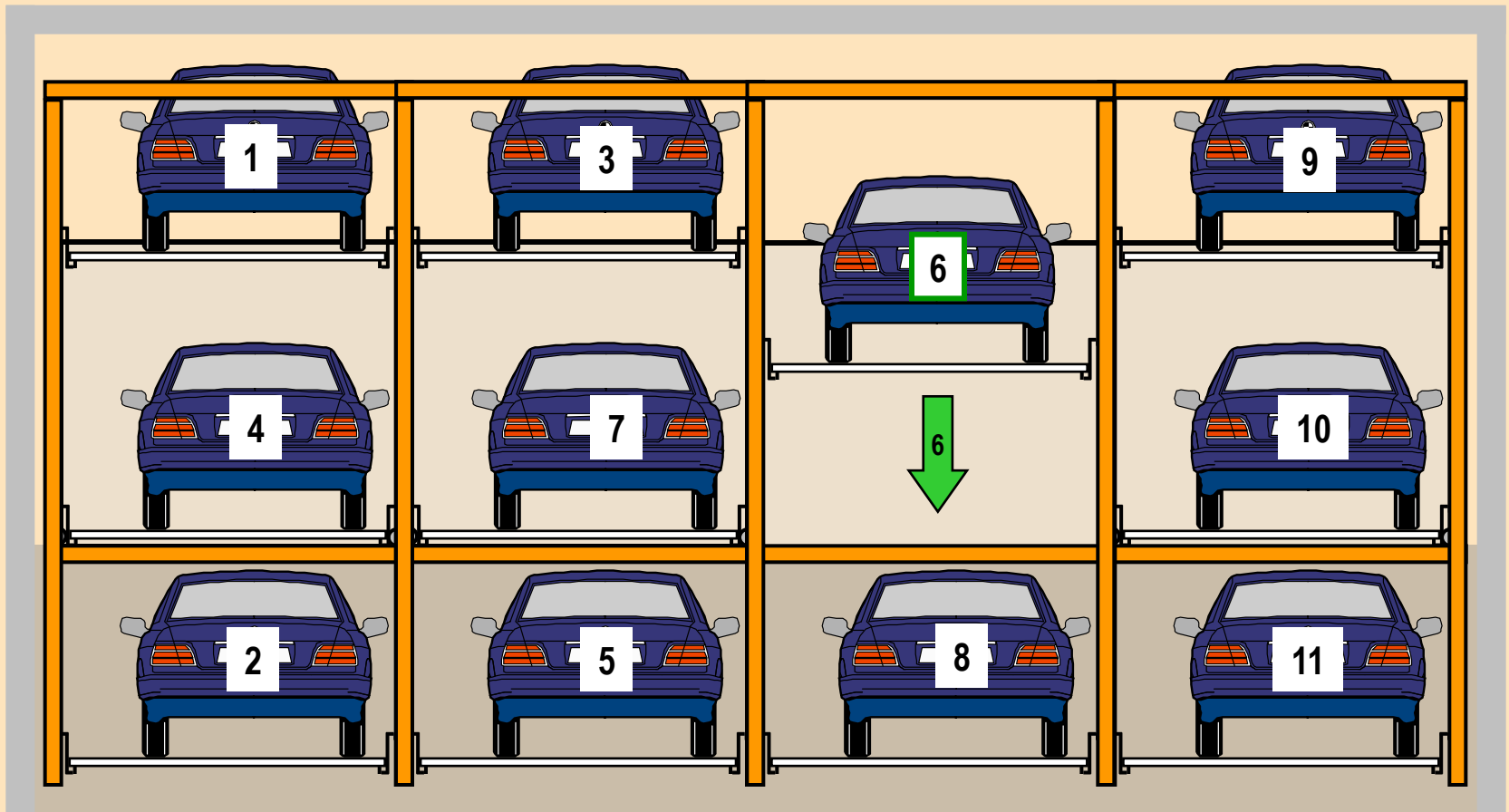
# Puzzle lift Functional Diagram of Operating Sequence for retrieval of car in parking Space 6



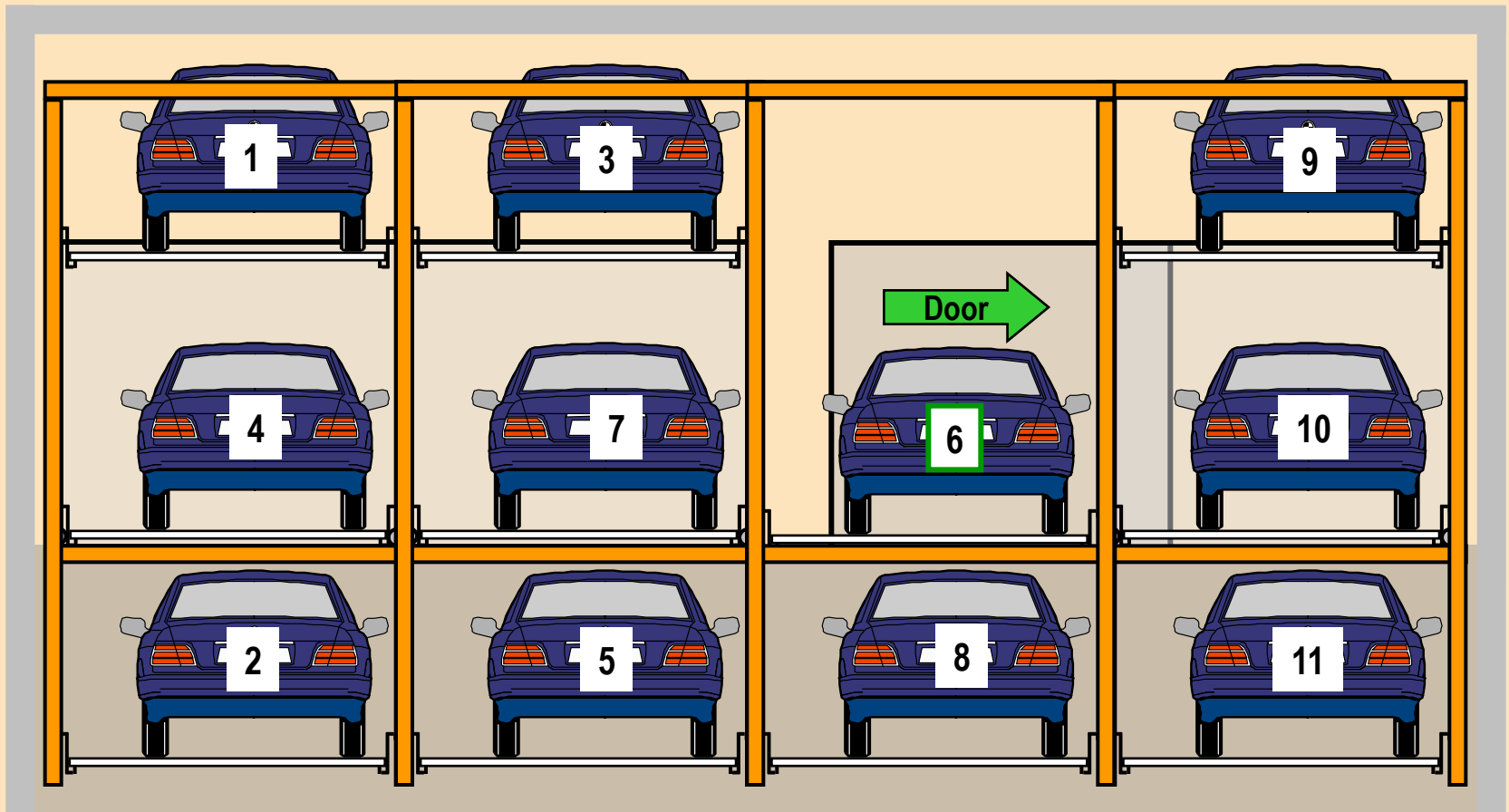
# Step 1: Middle level cars 4 & 7 move left to make space below platform



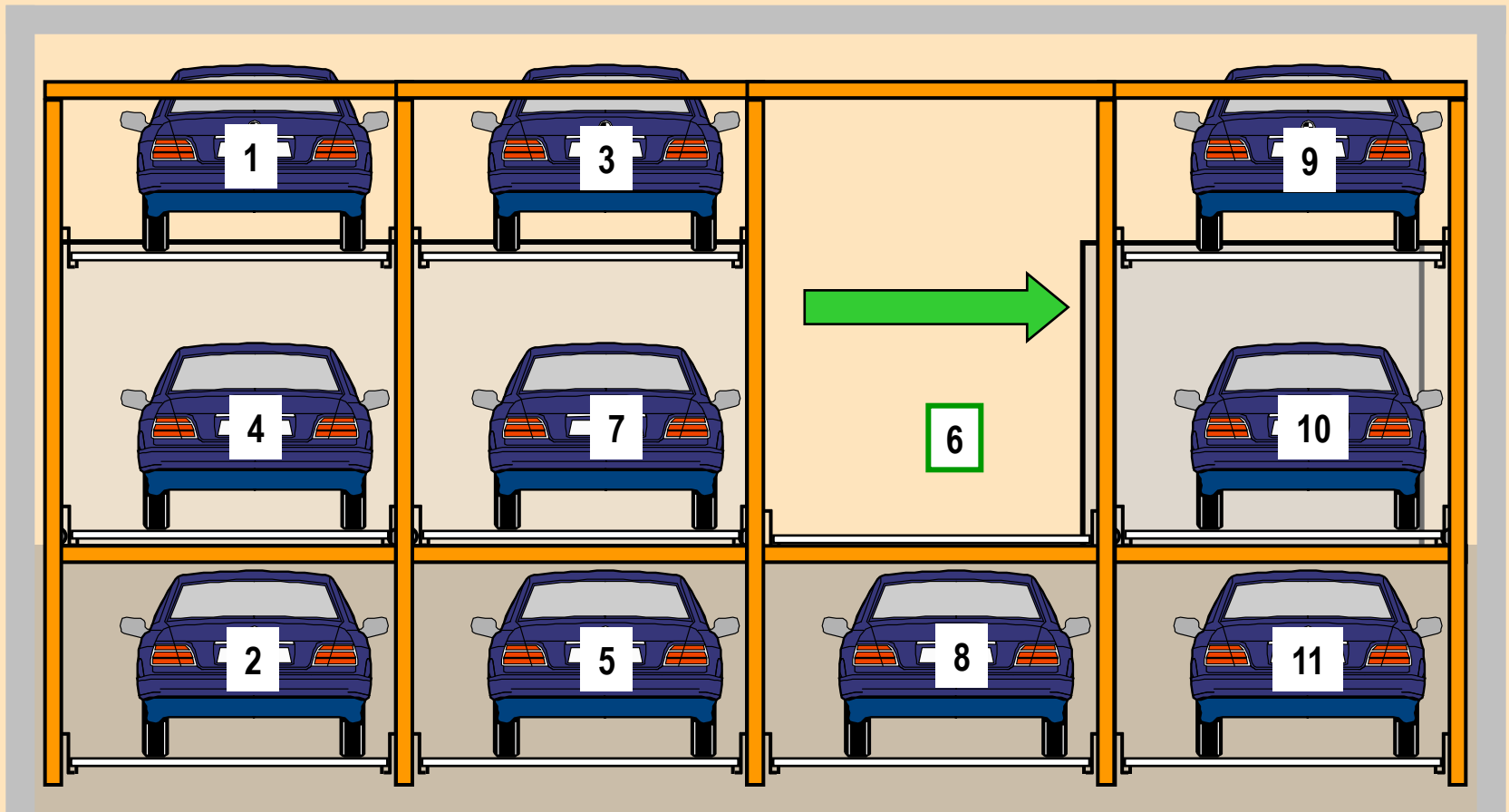
## Step 2: Platform with car 6 lowers to middle (driveway) level



## Step 3: Door opens to allow car 6 to drive out. Doors can be manual or electric with remote controls



## Step 4: User drives car 6 out.



# Three High Puzzle Lift



61 Cars- Apartments in Berkeley, CA



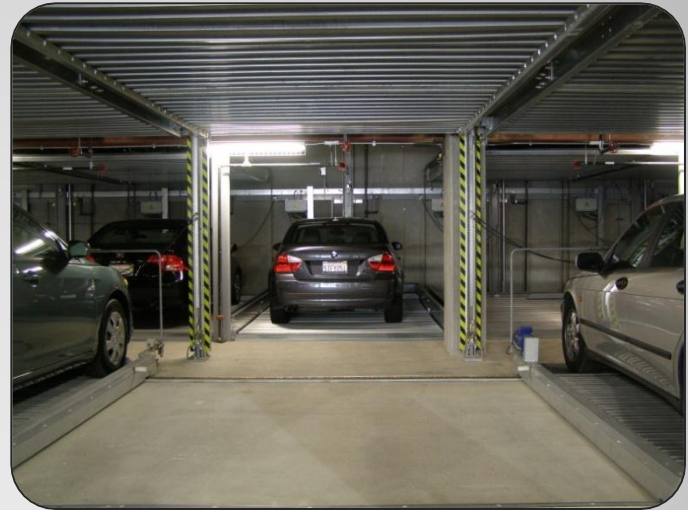
# Three High Puzzle Lift Animation

Video available in online format only



# Puzzle Lift Combinations

The Puzzle Lifts can be combined together with a two high version in front and three high, two high or normal parking spaces in the rear. The machine creates a space that the user drives through to get to the second machine. The machine takes approx. 39 ft of depth, but is extremely dense. A six wide (2 high / 3 high) combination machine holds 28 cars.

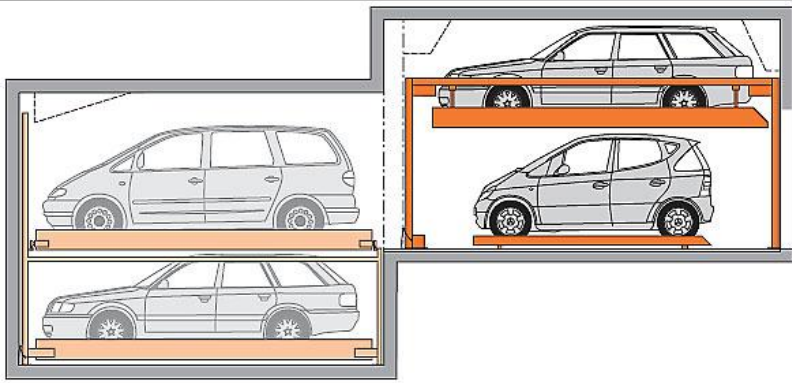


# Puzzle Lift Combinations

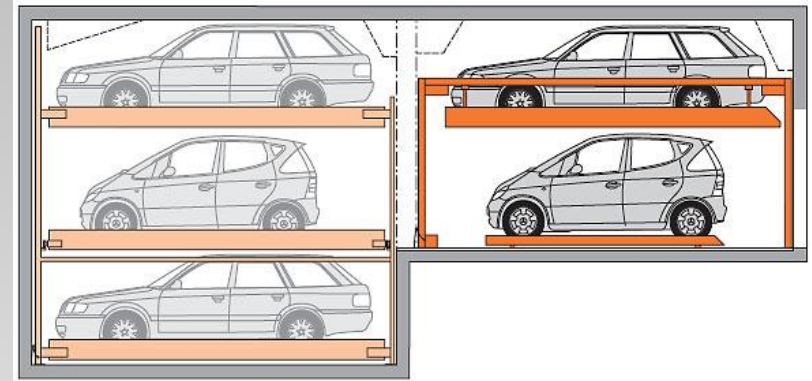
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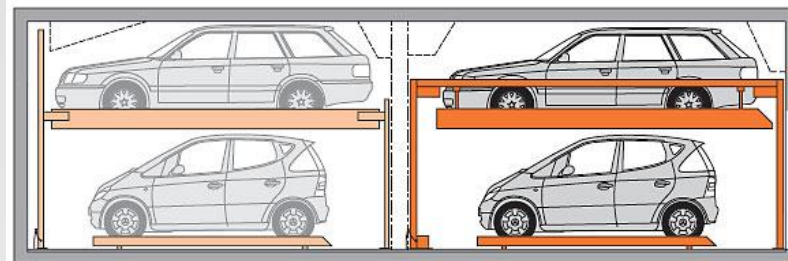
# Various Puzzle Lift Combinations



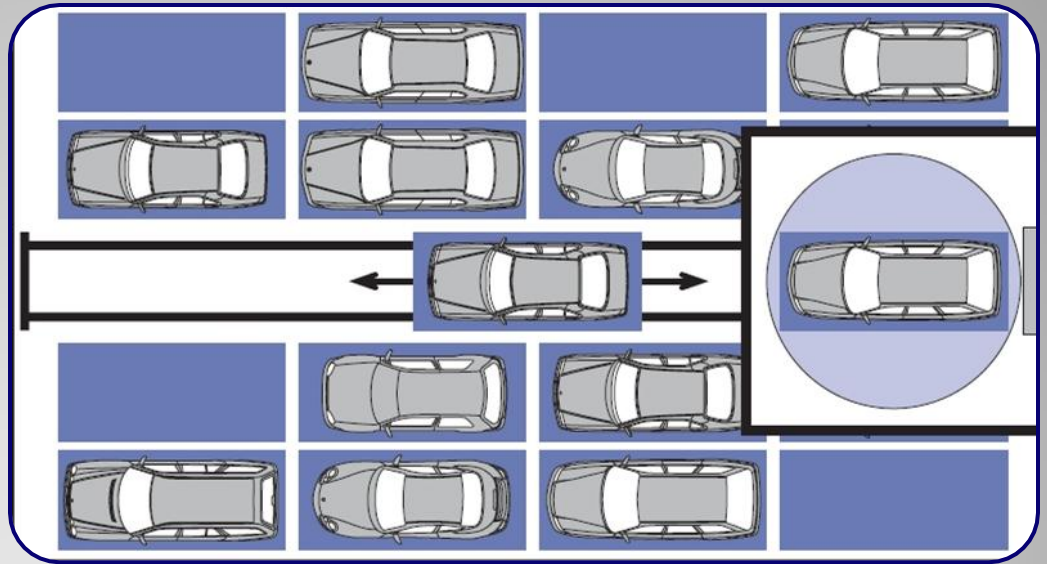
two high/ two high  
with pit combination



two high/ three high  
with pit combination



two high/ two high combination



# ADDITIONAL AUTOMATIC SYSTEMS

pallets – fully automatics



# Pallets

Pallets are another way to move cars around, they are especially useful in situations where there is not enough ceiling height to stack cars and a pit is not possible. They can provide independent access to what would be a row or rows of land locked cars.



# Pallet Animation

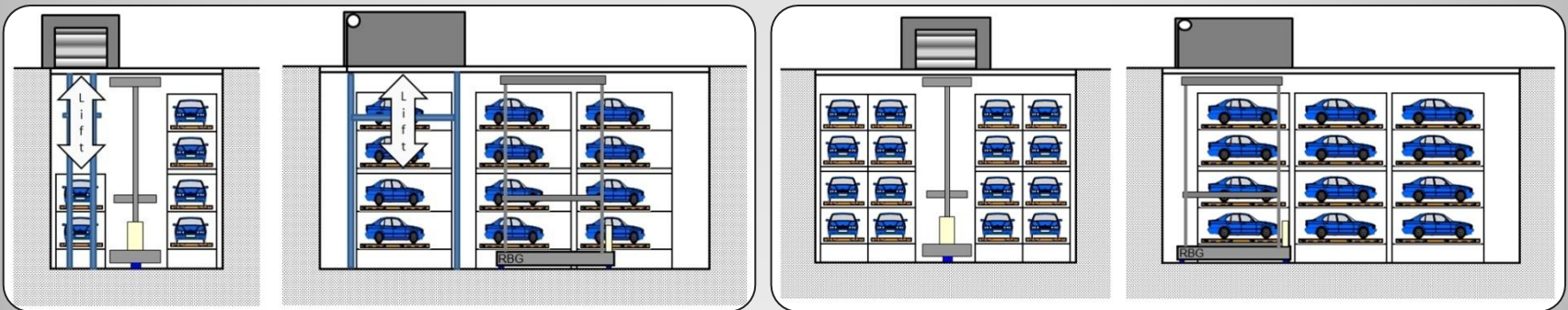
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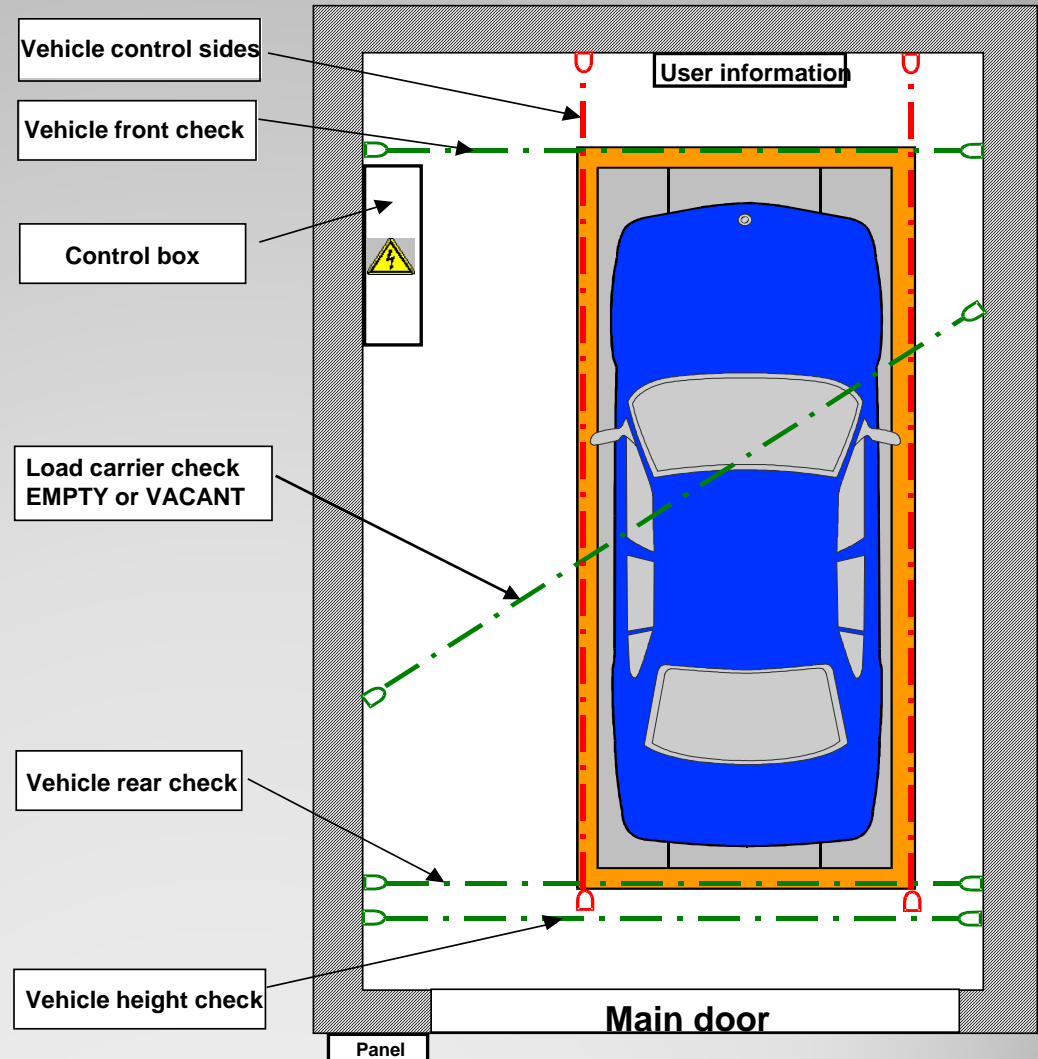
# Fully Automatic Car Parking Systems

- Fully automatics are useful if none of the previous standard models will work. The vehicle to be parked is placed in the entrance box and moved via lift to the storage and retrieval unit and put into the nearest available parking space. The vehicles can be stored lengthwise or perpendicular to the driving direction.
- The system can be used as an aboveground or underground system, or as a combination of both variants. Different vehicle heights can be realized by different floor heights.

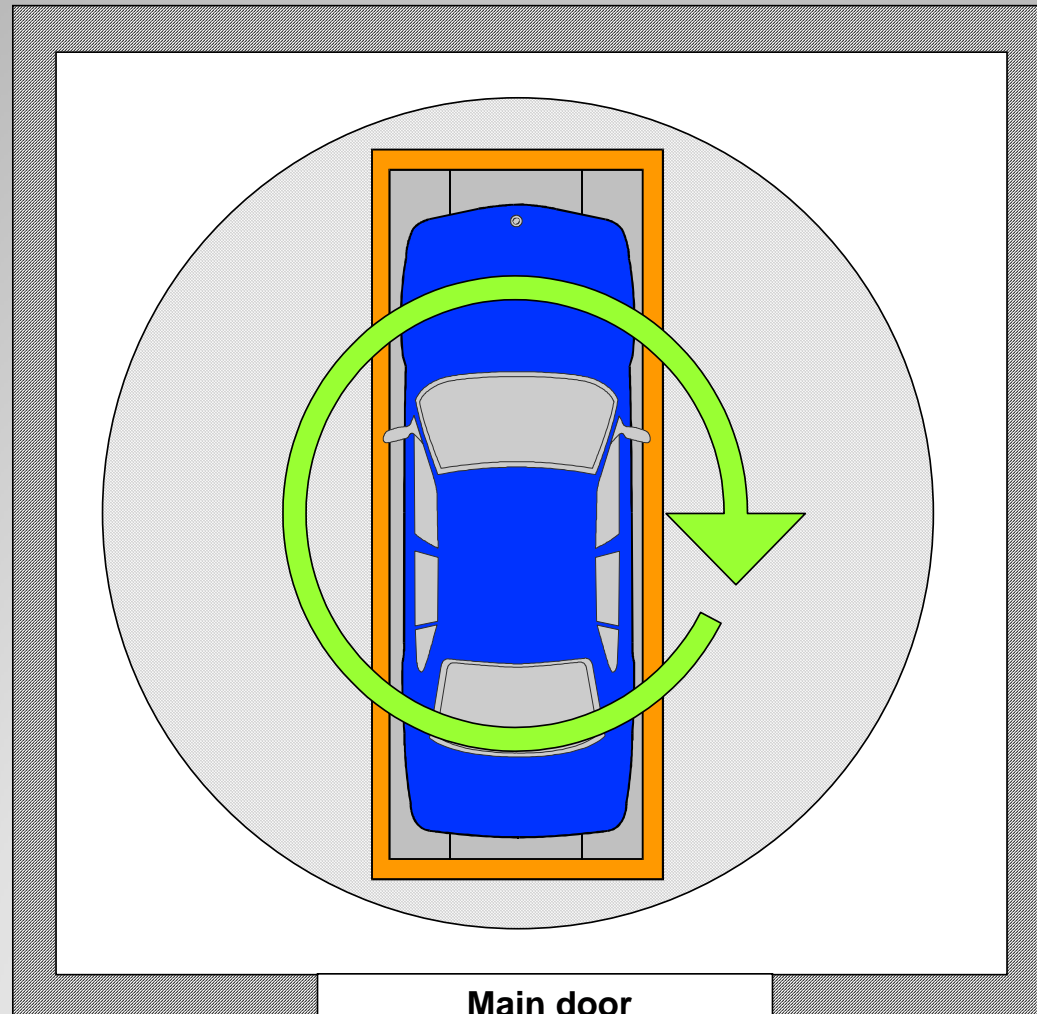


# Transfer Area / Entrance Box

Lasers check the car dimensions to make sure the vehicle will fit in the machine. The user is given instructions on a large screen in front of the car.



# Entrance Box With Optional Turntable



# Automatic Car Parking Systems

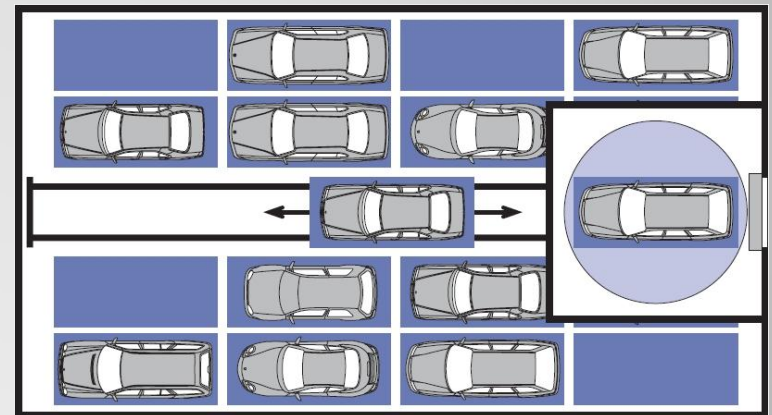
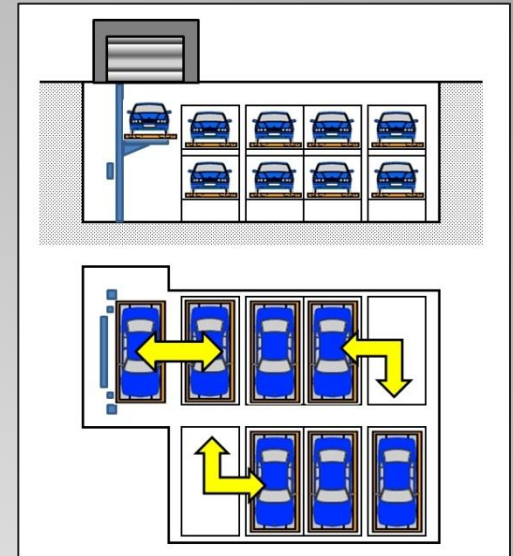
## Variants

- Shelf System
- Layer System



# There Are a Variety of Options

- The fully automatic machines are part of an extensive product line. Once a base model is chosen, the number of levels and rows can be customized for the needs of the specific project.
- Typically each entrance handles no more than 60 to 80 cars. Larger systems would be broken into multiple adjacent systems each with it's own entrance.





# Underground Example

## Entry Garage





# Fully Automatic Car Parking Systems

Most comfortable, space saving and efficient way to park cars.

## Procedure

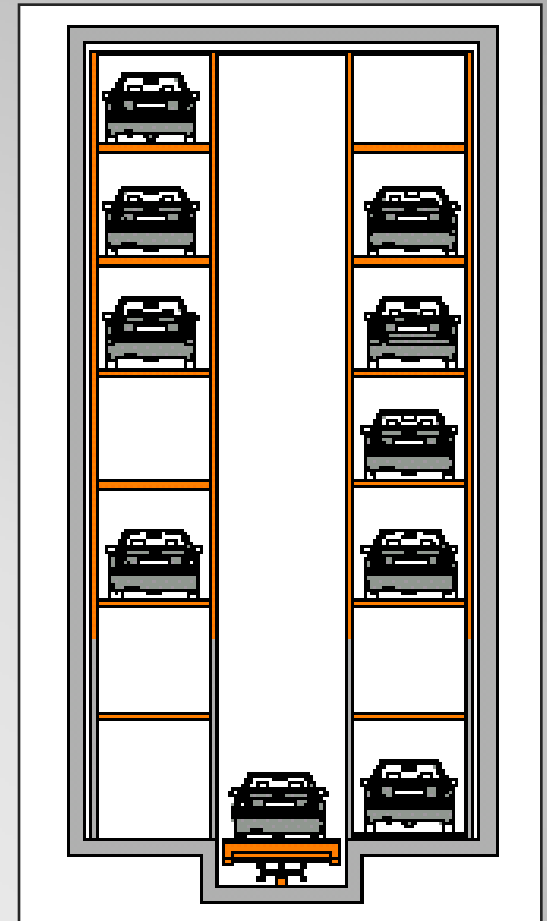
1. Park your car in the entrance box,
2. Entrance door closes
3. The lift stores your car
4. The computer saves your car location in memory

## Advantages

- Max. car park capacity in min. space
- Safe against crime and vandalism
- Environmentally friendly

## Disadvantage

- The most expensive solution





# CONCLUSION

concerns – benefits – summary

# Car Size Concerns

- The type of cars that need to be accommodated must be taken into consideration when choosing the model. All models come with a choice of widths and heights. Ceiling height usually comes with a cost and may involve a tradeoff with the size of vehicles that fit in the machine. A minimum ceiling height between 10' – 6" and 11' – 4" is generally required to accommodate passenger cars stacked two high. If SUV's are desired then an additional 1-2 feet of ceiling height is usually required.
- There are however a few cars that will not fit on any car lifts. Cars such as Hummers and Suburbans will need to be accommodated with a few at grade spaces as well as ADA spaces.



# Benefits of Mechanical Parking

- Can double or triple your parking capacity with little or no excavation
- Valuable ground floor space can be recovered for retail or other uses
- Can eliminate entire parking levels along with their ramps and drive isles
- The number of units which are able to be developed on the same site can be tripled
- Security in the parking area is improved
- Inexpensive to operate

# Course Summary

By now, you should be able to:

- Define mechanical parking
- Describe dependent access parking stackers' uses and limitations
- List the different types of independent access parking stackers
- Explain puzzle lifts, how they work and what their advantages are
- Describe fully automatic machines and why they might be used
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