MULTI STOREY CAR PARKING

BY:

KHAIRUNNUR BT MD SHAKRI
NUUR LAILY BT KHAIRUDDIN
A multi-storey car park or a parking garage is a building (or part thereof) which is designed specifically to be for automobile parking and where there are a number of floors or levels on which parking takes place.

- It is essentially a stacked parking lot.
- It is limited to 5 till 6 stories with the total capacity up to 500 cars per lot.
- Apply multiple access and exit system to avoid traffic congestion in and out.
Criteria for the quality multi storey car parks are:

- safety in use
- clear visibility
- parking-space marking to enable drivers to remember the location of their vehicles
- integration into the context of town planning
- clear views to the outside
- good natural lighting and ventilation
GENERAL GUIDELINES

- **Basement parking**
  - Appropriate for residential area, apartment, commercial complex, office complex and for area around airport that has building high control limit

- **Podium parking**
  - For medium and high density residential area, plus, office complex. Ground level until level 4 are used for the parking area, while residential unitS, office and other functional spaces are located above the parking level

- **Independent building for multi storey car parking**
  - For all building types that have large and adequate area for parking, such as low cost apartment, trade and city center, park and ride system at LRT station or railway station, bus station, institution, sport complex and mosque
  - Normally built separately if the building function is different

- **Roof top parking**
  - Appropriate for shopping complex (less that 5 stories) because it saves cost compared to basement parking

Source: Department of Town and Country Planning
MULTI STOREY CAR PARKING

TYPES OF PARKING

CONVENTIONAL PARKING / SELF PARKING

FLOOR SYSTEM

MECHANICAL ELEVATOR / AUTOMATED PARKING

RAMPS SYSTEM

LAYOUT

SYSTEM TYPES

- clearway
- adjacent
- Straight

TYPES

- split
- sloping
- parallel
- perpendicular

ANGLES

- 30°
- 45°
- 60°
CONVENTIONAL PARKING

RAMP SYSTEM

1) Clearway parking

- Interfloor travel path completely separated from potentially conflicting parking – unparking movements
- Provide safest movement with least delay
- Preferred for self park design
- Feasible for small garage sites
2) Adjacent parking

- Part or all of ramp travel is performed on access aisles
- Requires less area per parking stall
- Twofold use of travel paths
- Feasible for smaller land parcel
- More susceptible to traffic movement delays
- Has potential in causing accident
1) **Opposed ramp design**
- Vehicles rotate in the same direction
- Up and down ramps in opposite direction
- Required ramp surfaces to be opposed
- The operation is safer

2) **Parallel**
- Up and down ramp slope in the same direction
- Ramp surfaces are parallel
- Vehicles must rotate in opposite direction
- Cheaper to construct
**PARALLEL**

- parallel parking requires experience, confidence, and patience
- Parking spaces (min);
  - 7.5 meters long
  - 2.75 meters wide.

**Advantages**
- Works well in extremely narrow, linear spaces
- Requires minimum pavement area

**Disadvantages**
- Difficult maneuvering for most drivers
- Less than ideal visibility of adjacent traffic
- Inefficient use of on-street space
• Effective in low turnover rate or long term parking areas, the perpendicular, or 90 degree parking configuration is the most efficient and economical since it accommodates the most vehicles per linear meter.

• Standard dimensions for this configuration are:

<table>
<thead>
<tr>
<th>Description</th>
<th>Dimension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parking space width</td>
<td>2.75 meters</td>
</tr>
<tr>
<td>Parking space length</td>
<td>6 meters</td>
</tr>
<tr>
<td>Driving aisle width (2-way)</td>
<td>7 meters</td>
</tr>
<tr>
<td>Two rows plus aisle width</td>
<td>19 meters V</td>
</tr>
<tr>
<td>vehicles per 100 linear meter double row</td>
<td>82</td>
</tr>
</tbody>
</table>

Degree Parking Dimensions and Geometry
Advantages
- Works well with either one- or two-way aisles
- Handles the most vehicles per square meter of pavement
- Handles most vehicles per linear meter

Disadvantages
- Requires widest area
- Difficult maneuvering for some drivers
- Two-way traffic can create some visibility problems
- ideal for a fast turnover rate or predominantly short term use
- often offset by difficulties of inefficient circulation patterns and one-way aisles

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<tr>
<td>Driving aisle width (1-way)</td>
<td>5.5 meters</td>
</tr>
<tr>
<td>Two rows plus aisle width</td>
<td>16.5 meters</td>
</tr>
<tr>
<td>Vehicles per 100 linear meter double row</td>
<td>65.6</td>
</tr>
</tbody>
</table>
Advantages
• in and out of parking spaces
• Good visibility
• Lends itself to either one-or two-way aisles
• Most common short term parking configuration

Disadvantages
• Requires more pavement per vehicle than perpendicular configuration
• Handles less vehicles per linear meter
The 45 degree angled parking configuration displays similar benefits and limitations as the 60 degree.

Standard dimensions for this configuration are:

**Description Dimension**
- Parking space width: 2.75 meters
- Parking space length: 6 meters
- Driving aisle width (1-way): 4.5 meters
- Two rows plus aisle width: 14 meters
- Vehicles per 100 linear meter double row: 52.5
Advantages

- Reduced width requirements for layout
- Easy maneuvering in and out of parking spaces
- Good visibility to the rear

Disadvantages

- Doesn't work well with two-way aisles
- Requires more pavement per vehicle than perpendicular parking configuration
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<td>Vehicles per 100 linear meter double row</td>
<td>39.4</td>
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Advantages
• Easy parking
• Reduced width requirements for layout

Disadvantages
• Requires the most pavement per vehicle
• Doesn't work well with two-way aisles
Types of ramp

1) **Straight ramp**

- Usually rectangular shaped with ramp well along the structure’s longer side dimension
- More horizontal distance is required to satisfy ramp grade criteria than accommodate vehicular movement between ramp ends
- Requires less floor area and simple to construct
- Economical space on lot that is long and narrow
- Cause difficulties to get on and off straight ramp (Sharp turn)

- Having two ways circulation lanes on parking floor may be hazardous

- Up and down circulation lanes intersect on the parking floor unless the floor area is so large that each circulation can be kept within its own half on one-way lanes
• Single surfaces that permits vehicles to travel on a continuous helical path between parking levels

• Movement;
  Up-counter clockwise
  Down-counter clockwise
  Entrance and exit in the side

• Opposite side of ramp oil

• Directly above each other on succeeding floor

• Should be clearway type

• Continuous- 360° of rotation between two parking levels

• Located near corners of rectangular structure to minimize floor space loss but required more space than straight ramp (fit narrow site but waste more spaces)
• costly to construct
• Offer better traffic operation by providing gradual turning as compared to sharp turning movement usually required at ends of straight ramp
• Super elevation at ends of straight ramp create undesirable wrapping of floor areas
• No crossing of up and down traffic, even at parking floor connection
• Each traffic stream confined to its own ramp all the way from the top to bottom of the building
• Diameter of ramp is controlled by required turning radius (min 45 ft)
• Driver have a clear view each way even there is a crossing of traffic at each parking floor
1) **SPLIT-LEVEL OR STAGGERED FLOOR SYSTEMS**

- Floor levels in one section is staggered vertically by one half story from those in adjacent sections
- Applicable to small, high-cost sites where maximum use of space must be achieved

**Advantages**

- Construction is relatively simple
- The design fits well on rectangular sites
- Efficient in terms of floor space per vehicle parking stall

**Disadvantages**

- Frequent conflicts may arise between circulating traffic and parking and un-parking vehicles
Two-way staggered-floor ramp system

Tandem staggered-floor ramp system

This staggered-floor system provides parking on level floors and desirable one-way traffic flow—COMMON TYPE

Three-level staggered-floor ramp system
2) **SLOPING-FLOOR SYSTEMS**

- Consist of sloping levels (full width ramp/continuous ramp)
- Contains two adjacent parking modules tilted in opposite directions
- Well-suited to self-park operations

**Advantages**
- The relatively flat floor slope permits comfortable parking and pedestrian walking
- Each entering customer has an opportunity to park in the first available space as parking is adjacent to the interfloor circulation system
- Floor-to-floor travel distance is greater in sloping-floor garages than in other types of ramp garages

**Disadvantages**
- Cause congestion during peak out-bound movements
Sloping-floor system with crossover ramp of mid point

Double sloping-floor system with midpoint crossover
Automated parking is a method of automatically parking and retrieving cars typically using a computerised system of pallets, lifts and carriers.

Most suitable on expensive sites and where land is very limited - too small for economical development with a ramp parking.

Advantages:

- Increase capacity; high space utilization due to lower ceiling height, dense parking, and reduce space width.
- No ventilation or HVAC required; saving utility costs.
- Eliminates stairs, elevators and fire exits.
- Enhance safety and security.
- Typically requires less building volume and less ground area than a conventional facility with the same capacity.
AUTOMATED PARKING

- Disadvantages:
  - cost; operation and maintenance

- Many structural and functional types of automated mechanical systems exist, such as:
  - underground systems as part of the building foundation
  - above grade where they can match neighboring buildings in architectural appearance
Ramp break over angle
- Measure ability of the car to break over the steep ramp either climbing or descending without scrapping (Min 10°)
- Can be altered through design techniques
- Transitional blend top and bottom of ramps composed of two or more break point can multiply the steepness with workable break angles beyond the normal capacities of cars or driver
- Having pad of asphalt or concrete each side of break point so that the cars having low break over angle can negotiate potential critical points without scrapping

Angle of departure
- Min 10°
- To reduce incident of tailpipe and rear bumping dragging

Angle of approaches
- Min 15°
Ramp slopes
- Max 15%
- For slopes over 10%, transition at least 8 feet long should be provided at each end of the ramp at one half the slope of the ramp itself

Ramp grades transition
- Min 12 foot long = 1/2 of ramp grade

Ramp width
- One way straight ramp - min 12 feet
- Two way straight ramp - min 22 feet
- Circular ramp - min 14-18 feet

Ramp radius
- Single lane helical ramp - min 32 -37 feet
- Must kept min to conserve space and reduce travel distance
- Very sharp can cause dizzy

Ramp turn super elevation
- ½ inch/foot of ramp width at sharpest turning
- Ramp curves not too steeply
  a) Slow driver- difficult to keep way from inside edge of ramp pavement
  b) Fast driver- encourage to speed greater than conditions of grade and sight distance safety permit
**Driveway exits**

a) *Ramp driveway exit rising up to public sidewalk*
   - have transition section min 16 feet long at almost level before intersecting the sidewalk
   - Prevent hood of the car from obscuring the driver’s view of pedestrians on walk

b) *Property line wall*
   - Must not interfere with the driver’s view of pedestrian on public sidewalk.
   - If exit driveway is parallel and adjacent to the property line that extends all the way to sidewalk, edge of the driveway should physically establish by curbing or railing.
   - min 6 feet from the wall.

**Ramp grades**

- Computed by : floor to floor height x 100
  \[
  \text{Ramp length}
  \]

- Max ramp grades :
  a) *self park design*
    - not exceed 15 %
    - not exceed than 10% if had a pedestrian walkway on vehicles ramp
  b)*sloping floor self park design*
    - ramp grades max 4%  
    - angle parking 60°-minimizes gravity roll back of vehicles
Ramp appearance

Architectural and optical effect

• Ramp wall
  - Painted with stripes contrasting to wall color
  - Parallel to ramp surfaces or at steeper angles
  - Use paint marking in between vertical column and travel way
  - Built structural features with architectural lines parallel or perpendicular to ramp surfaces

• Ramp structures
  - Open; to provide sight distance and reduce closed in impression

• Ramp illumination
  - Wall opening are restricted; distract the driver’s view
  - Artificial lighting should take form of diffused illumination
  - Reflector should pointed away from the direction of travel

Signs and Wayfinding

• Color-coding, numbering, visual cues, music, and even machines for marking your ticket with your exact location to locate your car for easy retrieval

• Locate signs in areas where driver can read in a timely fashion

• Clear, simple, and direct messages

• Floor coding can be useful

• Signage should locate all major internal pedestrian access points as well as external major roads and buildings
Vehicle control

Fee collection
• Fixed or variable charged pay on exit

Barrier capacity
• 2 barrier types available
  - Rising arm
  - Rising kerb
• Entry barrier  400 vehicles/hour
• Exit barrier  250 vehicles/hour

Lighting
• Services illumination for public should be (lux);

  Parking areas  20
  Driveways      50
  Ramps          70
  Roof           20
  Entrance and exit  150
Security and Safety

- Open, glass stairwells and glass-backed elevators
- Security devices
  - video, audio and emergency buttons that call into the booth or local police station
  - Public telephones
- Eliminate potential hiding places, such as under open stairs
- Handicap accessibility with vehicles close to stair and elevator cores have a direct path to key movement patterns of the garage
- Ventilation
  - avoid carbon monoxide build-up, designed adequate air flow for through mechanical and/or natural
- Non-slip floor surface
  - ensure safety of movement of the man and automobile
- Energy efficiency in lighting
  - balance between day lighting, interior lighting and exterior control especially on the exterior design of the façade while providing adequate lighting within
  - Lights should be vandal resistant and easy to maintain.
Fire and precaution

Structural fire resistance
- Use non-combustible materials in the construction with structural fire requirement 1 hour in specific restricted circumstances requirement for structural fire requirement may be waived for building less than 15.2m high
- Eg: Cast in place concrete, pre-cast concrete and structural steel

Means of escape
- All parking spaces within 45.7 m of escape stairway having 1 hour fire requirement

Fire precaution
- Have adequate
  - fire bridge access
  - Dry rising main
  - Fire points